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county  
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January

1950

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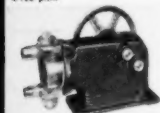
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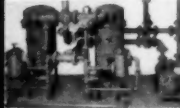


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Some of the articles  
in this issue

Setting Funds for  
Public Works Planning

Winter Maintenance in  
Washington, D. C.

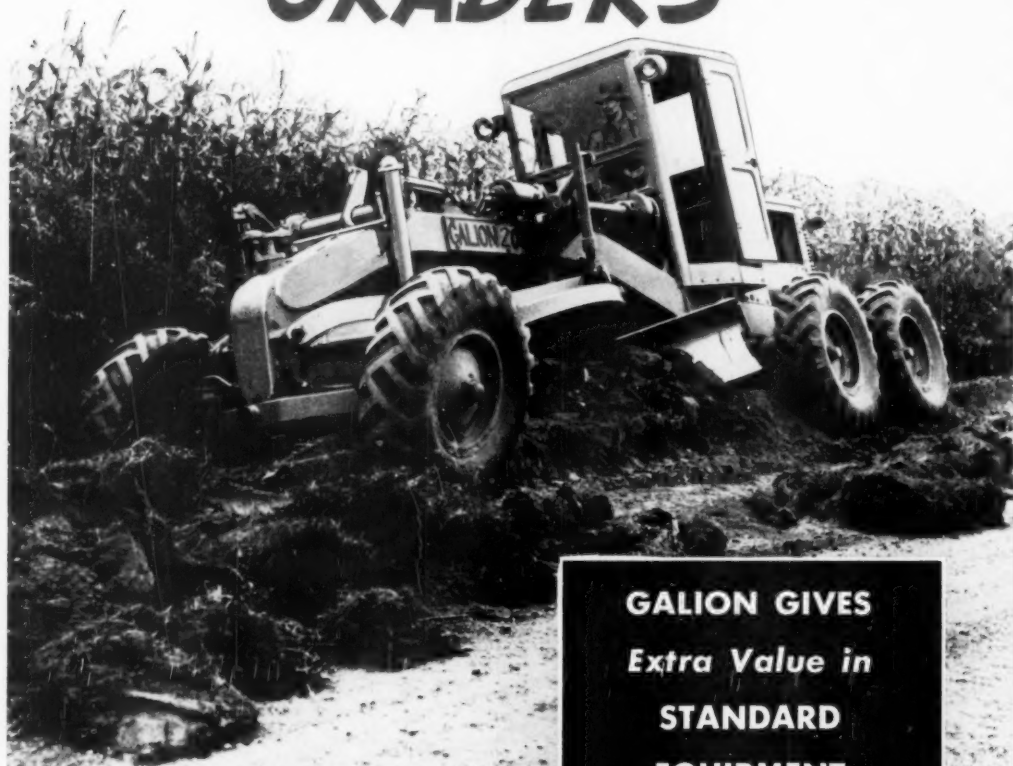
Sanitary Instructors  
for Alabama, 1949

How to Control  
Pipe Line Surges

Complete Contents  
Listed on Page 5

# ***GALION* NO. 116, NO. 103, NO. 202**

## **EXTRA VALUE GRADERS**



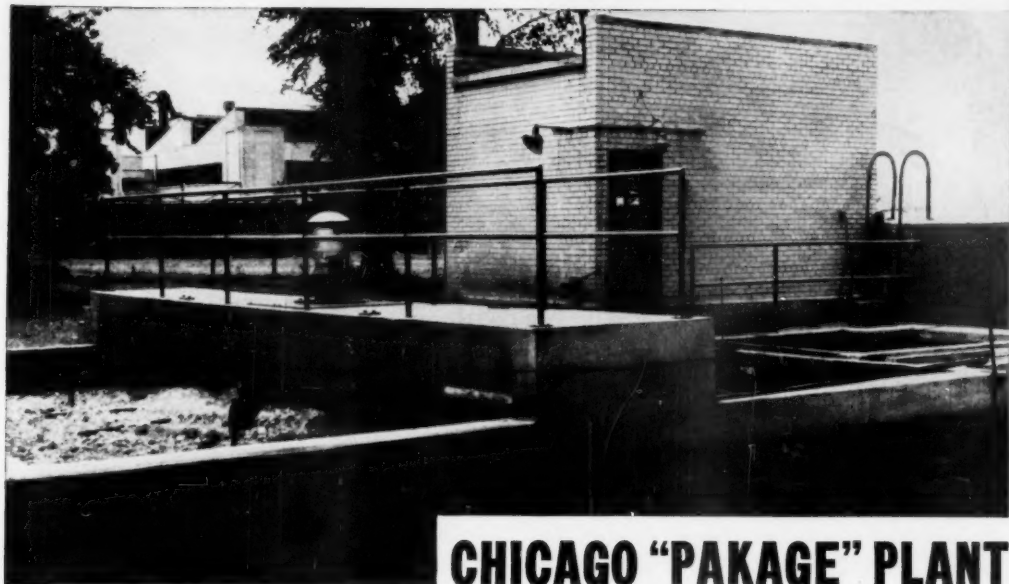
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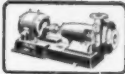
The "Package" plant was specifically developed for small populations and can be engineered to meet requirements. Complete literature available.

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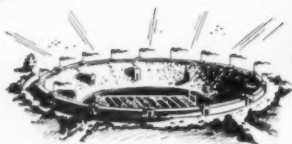
Flush Kleen, Scrub-Peller, Plunger,  
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# Public Works

**THE ENGINEERING AUTHORITY  
IN THE CITY-COUNTY FIELD**

*Edited by*  
**W. A. HARDENBERGH and A. PRESCOTT FOLWELL**

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# THE EDITOR'S PAGE

## The Problem of Where to Get More Water

**B**ECAUSE, in company with many other communities, our biggest city, New York, is facing a water shortage, we are hearing a good deal about a problem that informed water supply engineers have known about for a long time. The problem is where to get more water for our cities and our industries. It is not possible to make our rains more frequent or better spaced; it isn't practicable to remove dissolved materials from sea water; nor to manufacture water.

There are some things that can be done, however. We can institute research into better and more effective methods of ground water recharge. We can study the possibilities of conserving industrial waters through reuse and better methods of treatment. And we can utilize our sewage plant effluents so as to recover this water for certain uses. To do this may require a stepping up of treatment, but that can be done and we know how to do it.

It may be that not so many people know how serious our present lack of water is. It would pay, for instance, to build a steel mill on the eastern seaboard, using high grade ores that could be shipped in by water, but in the area between Boston and Washington, it is doubtful if there is any source of water supply that would meet the requirements for such a plant.

For an army cantonment, there are three basic requirements—suitable terrain for training, transportation and water supply. Of all the sites in the country where the first two requirements are met, there are probably less than half a dozen, not already used in the past, where there is adequate water supply.

Perhaps your editor should begin again on a war-time project that yielded a great deal of fun in the days when most everyone had a pet research project to help the war along. His project was to develop a dehydrated water for invasions, which would require only that water be added to it for troop use. Some folks took him seriously, but most of them appreciated the joke.

## Hari-kari and the Bible

**S**HORTLY after the Army Medical Department committed hari-kari, so far as effective utilization of the non-medical professional personnel was concerned, this department expressed its views in a comparatively mild manner. Since that time there has been a steady demand for more of the same; however, we can see no use in further public rumpling of the soiled linen.

There are, though, one or two factors worthy of consideration. Nearly a year ago, a group of highly capable engineers, at the suggestion of Medical Department officers and with the full concurrence of the writer, undertook friendly negotiations toward changing the existing unsound Medical Service Corps setup. Reports to date show no substantial progress whatever. Nor has there been any progress in providing training for MSC reserve officers of the pro-

fessional groups. So far as we can find out, they can listen to medical lectures, they can join up with other branches for training; or they can go inactive.

The brand of progressiveness being exhibited in these matters by the Medical Department and the Medical Service Corps reminds us of the 8th verse of the 13th chapter of Hebrews.

## Street Parking Costs Money Too

**T**HOUGH most everyone realizes the need for off-street parking areas not so many do anything about it. The cost, which may run from \$500 per car up, is a deterrent. A recent study of the Eno Foundation brings out an important point. This revealed that the capital investment by a city amounts to \$1,193, on the average, for each parking place provided on street rights-of-way, assuming land value of the right-of-way is \$5 per square foot and the pavement cost \$6 per square yard. This isn't cheap; and if we don't want to go through a program of street widening, which usually costs real money, it's about time to plan on those off-street parking facilities.

## The Illinois Pollution Control Law

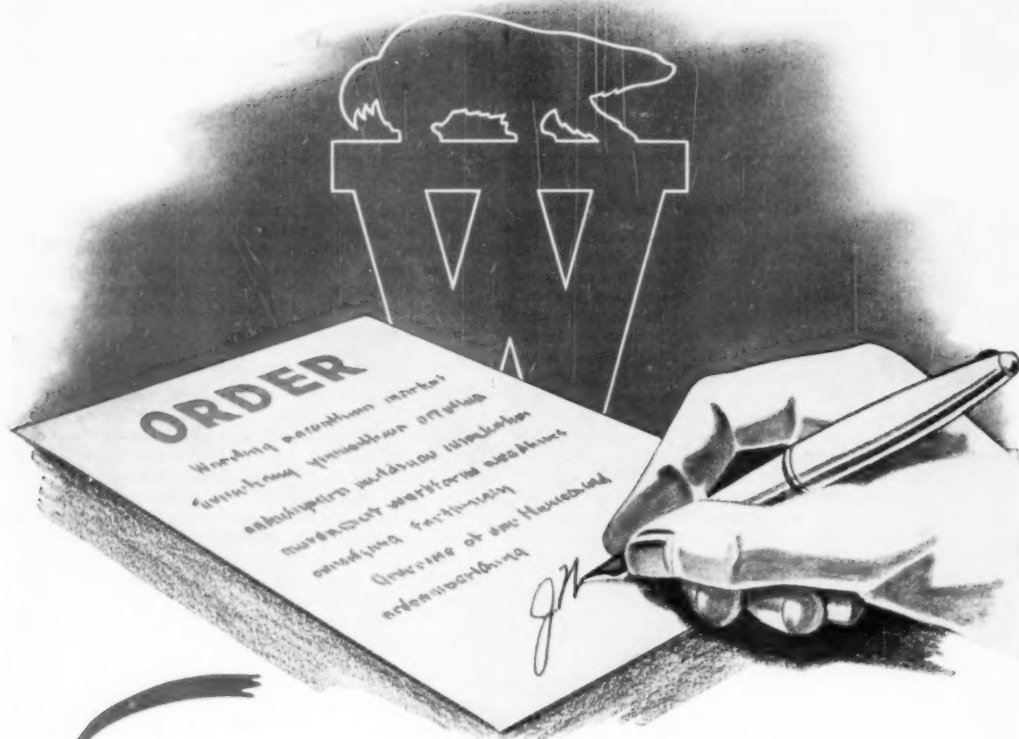
**T**HANKS to amendments to its water pollution law passed by the Legislature this year, the Illinois State Sanitary Water Board now has jurisdiction over "all substances and materials which pollute, threaten to pollute or tend to pollute" surface or underground waters. It can call on the Circuit or Superior Courts for a prohibitive injunction in any case where it is the opinion of the Board that any person or other public or private entity is about to do or fail to do anything that would violate any of the rules regulations, or requirements.

In many other states the courts have refused to grant injunctions against the construction or operation of plants which threaten to pollute streams until such pollution has actually occurred and has been proved to the court, with possibly large sums invested in the offending plant. Illinois can now prevent the construction of a plant or the inauguration of a procedure if its Sanitary Water Board is of the opinion that pollution of public water would be caused thereby.

Prevention is vastly better than cure.

## Don't Forget that Public Works Planning

**E**VERY engineer knows that it takes from six to twenty-four months to bring an engineering project to the stage where construction can begin. To translate needs into either structures or employment takes time. We should get into the habit of having a reserve of public works plans ready in case of need. The recent action of Congress in making available funds which may be used as interest-free loans, to be repaid when construction starts, makes it possible for every community to practice advance planning of public works.



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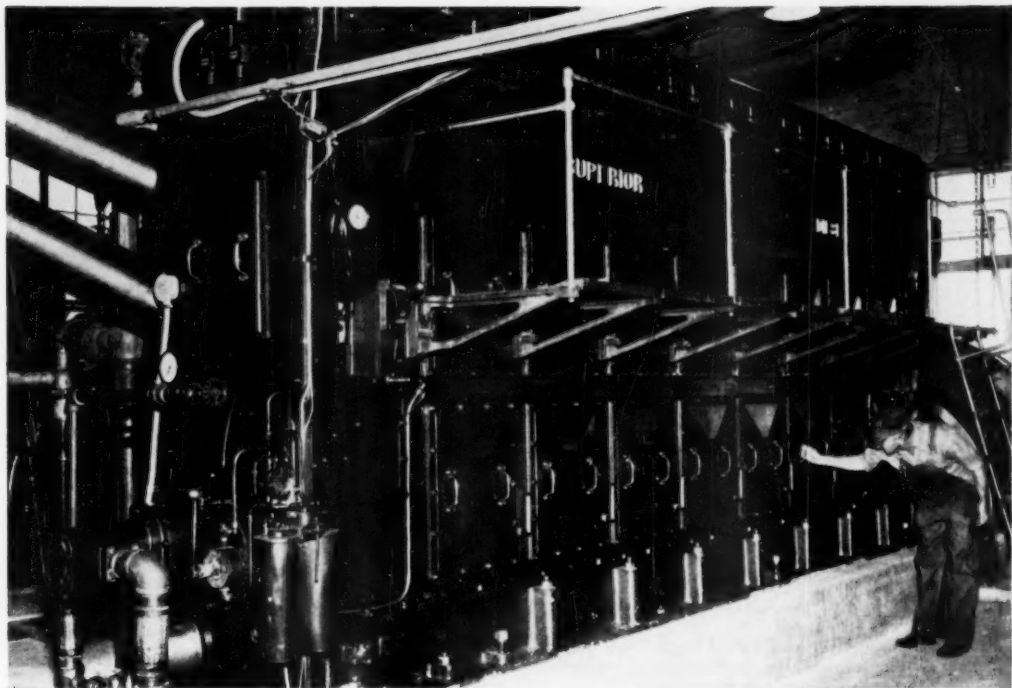
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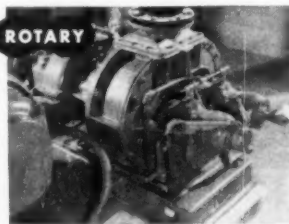
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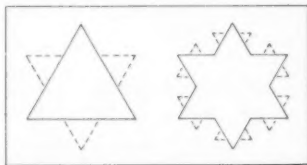
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### LOOK OUT FOR THIS

Did I ever tell you of a curiously interesting exercise in the mathematics of pipe capacity? If not, here goes: **THEOREM:** By increasing the inside area of a conduit according to a special method, one can reduce the carrying capacity of the conduit—the greater the inside area, the less the carrying capacity. **GIVEN:** A conduit having the shape of an equilateral triangle for its interior. **CONSTRUCTION:** From each side remove the middle third and add equilateral triangle-shaped areas to make the conduit whole again. Repeat the process indefinitely. From here on, you are on your own, but the theorem can be proved.

Benjamin Eisner  
Huntington Bank Bldg.,  
Columbus, Ohio.



### Method of developing conduit.

(Ed. Note: We pass this on to our readers with the warning note that heads this item. Ben Eisner is one of the finest mathematicians we know of, and we are not at all in his class.)

### THE ORDER OF THE GELD

Your editorial about the Order of the Boar was written too soon. It has been reported that a so-called Boar meeting was held in Chicago recently, and that the midwestern section of the Order has been taken over by the doctors. At this meeting some twelve doctors, together with others outside the Sanitary Corps, whose qualifications were not made known, were initiated.

The medics . . . are apparently ready to supervise the social functions of the sanitary engineer as well as his professional activities. The



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members of the Order of the Boar in my office feel that an engineering committee should pass on all shoats before they are approved for membership.

A Midwest Sanitary Engineer.

(Ed. Note: We knew about the above-mentioned meeting when we wrote that editorial, but we catalog the group you comment on as the Order of the Geld, and did not class it as a meeting of the Order of the Boar. We understand that this meeting at Chicago reached a new and shocking low in vulgarity, even for medically controlled meetings. This letter printed here is but one of a number of comments we had on this unfortunate circumstance.)

### BOOKS IN BRIEF

#### EXAMINATION OF WATER

This book is based on English data, but is unusually complete and thorough. There are 819 pages and 52 illustrations in this sixth edition. Chapters cover geology, inspection, scope of examinations, analytical processes and methods, bacteriological examinations, water supply and disease, and purification and treatment. By E. W. Taylor. Blakiston Co., Philadelphia, \$12.

#### CONCRETE PAVEMENTS

Latest thinking of the 48 state highway departments on concrete pavement practices has been summarized by the ARBA in a 122-page text. It covers subgrade soil practices, concrete materials, proportioning, placing, finishing and curing. Ask for Bulletin 163. \$1. American Road Builders' Ass'n., Washington, D. C.

#### ENGINEERING CONTRACTS & SPECIFICATIONS

In this book, emphasis has been placed on the practical technical and legal pitfalls to guard against in writing contracts and specifications. 327 pages. By Robert W. Abbett. John Wiley & Sons, Inc., \$3.75.

#### LOCAL FINANCING OF HIGHWAYS

A long-term study by the Bureau of Public Roads is reported in this booklet which has, as its complete title "The Financing of Highways by Counties and Local Rural Governments, 1931-1941." There is much tabular matter covering receipts, expenditures and debt for rural highways. For sale by the Superintendent of Documents, Gov't. Printing Office. 45¢.

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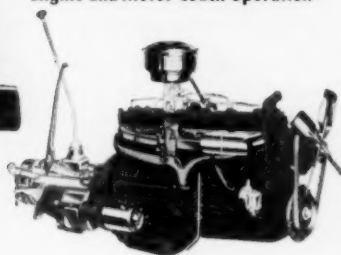
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**THE NEW FORD 254 ENGINE**  
gives you all these modern design features!

**CHROME-PLATED** top piston ring for better lubrication, longer cylinder life.

**AUTOTHERMIC** aluminum alloy pistons with solid skirt. Steel strut controls piston to wall clearance.

**HIGH-LIFT** camshaft for increased valve opening, greater power.

**FREE-TURN** exhaust valves. Self-cleaning, better seating, longer-lived.

**COBALT-CHROME** faced exhaust valves for hard contact surface giving longer wear.

**HIGH-TURBULENCE** Power Dome combustion chambers for more power, greater economy.

## Ford Trucks Cost Less because FORD TRUCKS LAST LONGER

Using latest registration data on 6,106,000 trucks, life insurance experts prove Ford Trucks last longer!

When writing, we will appreciate your mentioning PUBLIC WORKS

# TWO-FISTED EQUIPMENT

## *for a two-sided job*

**The scene:** Third District, Mendocino County, California. **The job:** A road-widening bank cut-back and a shoulder-building fill, 2¼ miles apart. **The hauling equipment:** A fleet of "Caterpillar" DW10 Tractors and W10 Wagons matched and "fisted" for truck-speed hauling and big-capacity (14-heaped-yard) loads.

That's the setup under which *two* widely separated road-improvement jobs were handled virtually as one. Aided by hydraulically controlled bottom doors, loads were windrowed quickly, and the 9-mile round trip completed in 35 to 40 minutes. Fast work indeed! Big daily volume! And at decisively low cost!

With 312 miles of roads to be looked after, the District's taxpayers are certainly getting a big return for their money through the use of what owners frequently describe as "the fastest and most dependable earthmoving equipment." Or, as "Jack" Purdy, Road Foreman, puts it: "You can't beat these rigs. They really move dirt. I've been here 14 years and I've never seen anything that will take the beating 'Caterpillar' equipment will. To say I'm satisfied with it is putting it mildly."

Do you want more information? See your "Caterpillar" dealer. Meantime, use the coupon.

**CATERPILLAR TRACTOR CO. • PEORIA, ILLINOIS**

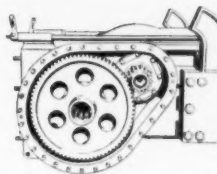
NOTE. DW10s are also available with matching "Caterpillar" No. 10 Scrapers and Athey PD-10Q rock trailers.



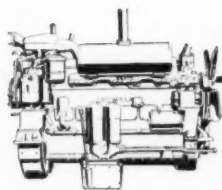


*Look under the hide*

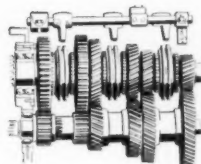
**OF THE "CAT" DW10**



**SPEEDS UP TO 24.5 MPH.** Three complete ranges of speed are available with a choice of final drive gears. Many operators keep all three sets in stock to fit their DW10s to the job, ground conditions or haul distances. Differential-type rear end, combined with steering brakes, enables the DW10 to "walk" through soft spots on the fill. Full-floating drive axles are an assurance of dependable performance under the roughest of conditions.



**ALL-"CATERPILLAR" BUILT.** Undivided manufacturer responsibility! Engine, transmission, clutch and final drive—all are 100% "Caterpillar" built and designed for each other. The engine, 115 honest horsepower, is known the world over for its dependable and economical performance. Its own independent gasoline starting engine is itself started electrically, or can be started by hand in case of battery failure. The engine is the heart of your operations... use the best.



**QUALITY BUILT.** Typical of the quality designed into the DW10 is the constant-mesh, easy-to-shift transmission. A gear-type pump forces oil over the upper shaft to lubricate effectively the transmission on any grade. To insure long life, a large replaceable filter element guards against destructive abrasive materials. Just one of the many features that can boost production for you.



**EASY SAFE OPERATION.** One way to get high earthmoving production is to design equipment for safety and ease of operation. Four-wheel stability; hydraulic booster steering; selective-acting air brakes on the DW10 and trailed unit; hydraulically controlled spring-mounted seat and unexcelled visibility—these add up to all-important reasons why operators prefer DW10s.



**EASY TO MAINTAIN.** "Caterpillar" has always designed for ease of service. Fuel injection equipment that can be replaced like spark plugs, with no adjustments required; a metallic-lined double-disc flywheel clutch that can be removed without disturbing engine or transmission—these are just two of many reasons why owners report full satisfaction. Hundreds of well-equipped "Caterpillar" dealers, each within easy job distance, constitute another reason why DW10s boost hauling profits.

# CATERPILLAR

REG. U. S. PAT. OFF.

**DIESEL ENGINES**

**TRACTORS**

**MOTOR GRADERS**

**EARTHMOVING EQUIPMENT**

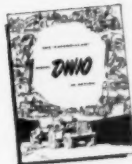
**CATERPILLAR TRACTOR CO.**

Dept. PW-1, Peoria, Illinois

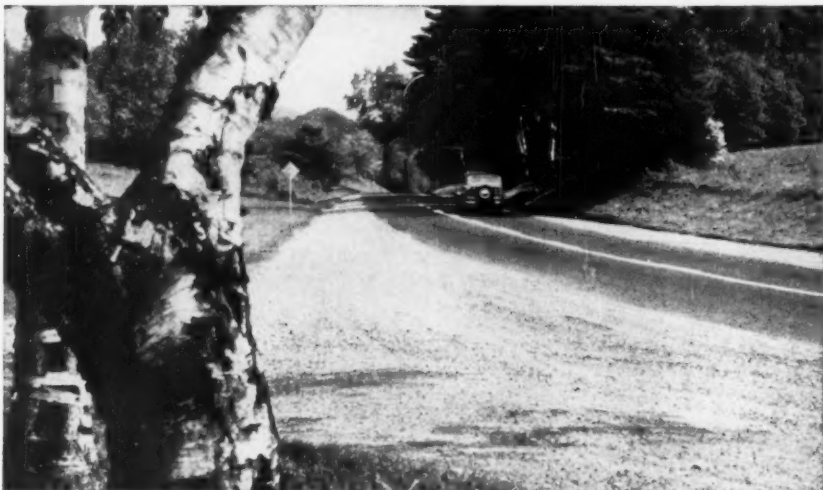
Please send me your latest booklet, "The 'Caterpillar' Diesel DW10 in Action."

Name \_\_\_\_\_

Address \_\_\_\_\_



## FOR YEAR 'ROUND ROAD SATISFACTION



Roads built with TARVIA® road tar are restful on the eyes and add to the attractiveness of any landscape. Even under hot summer suns, they are glare-free—take the strain out of driving.



Roads built with TARVIA road tar are not affected by calcium chloride or sodium chloride. Their black surfaces absorb heat. Result? Roads easier to keep open—easier and safer to ride on.

Barrett's 46 years of experience in road building, maintenance and repair is yours for the asking. Ask the Barrett field man.

### THE BARRETT DIVISION

ALLIED CHEMICAL & DYE CORPORATION  
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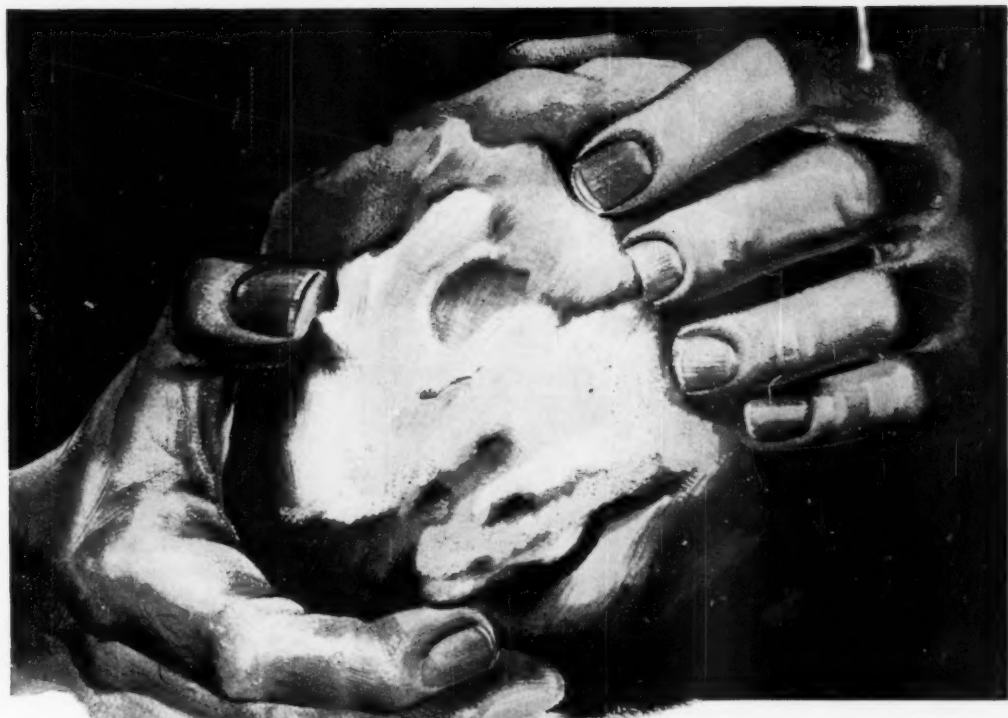


The slightly granular, "tractionized" surface of TARVIA road tar pavement gives tires a firm tread-hold for safer driving.

**Barrett**  
**Tarvia**  
ROAD TAR

\*Reg. U. S. Pat. Off.

When you need special information—consult READERS' SERVICE DEPT. on pages 69-73.



# CLAY...

## RAW STUFF OF THE *Only* CORROSION-RESISTANT PIPE

Vitrified Clay Pipe is the only pipe offering complete protection against acids, alkalis, and chemicals. Proof? *There is no instance on record where a single length of Clay Pipe has ever worn out due to the action of a disintegrating agent.* This explains why 89% of America's sewerage lines are made of Vitrified Clay Pipe. On any sewerage or drainage project, be sure by specifying Vitrified Clay.

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SPECIFY

*Vitrified*

**CLAY**



**PIPE**



CLAY PIPE  
FITTINGS



PERFORATED  
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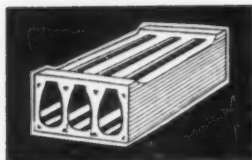
STANDARD-  
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C-150-1

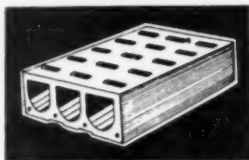
When writing, we will appreciate your mentioning PUBLIC WORKS

## TODAY'S FILTER PLANTS

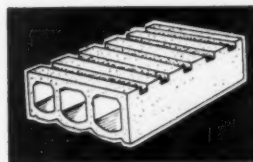
use vitrified clay  
filter bottom blocks



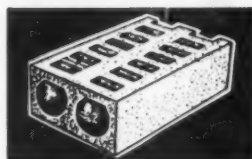
Natco



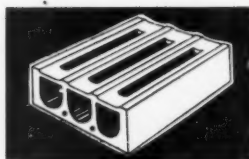
Dickey



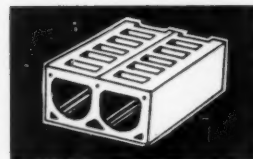
Translot



Armco



Pomona



Bosco

## For Best Results In Your Next Trickling Filter . . .

Use the underdrain blocks that have proved themselves in hundreds of installations across the nation. Large openings in the tops allow air to circulate freely while carrying the sewage out and help maintain aerobic conditions at all times. Solids cannot cling to the mirror-smooth channels in the *Vitrified Clay Filter Bottom Blocks* made by members of the Trickling Filter Floor Institute.

Each block is provided with the inner surface super-smooth to give the finest operating results. But

they have other advantages too. They are easy to lay, even with unskilled labor. They are self-aligning and convenient to work on after laying. These are specially designed, the finest quality blocks made and come with standard fittings for use in any type or shape trickling filter.

For life-time, trouble-free service—and best results—always specify *Vitrified Clay Filter Bottom Blocks*. Write any of our members for latest engineering data.

### Special Advantages:

WON'T CLOG

EASY TO LAY

PROVED BY USE

RESIST ACIDS

LAST A LIFETIME

## TRICKLING FILTER FLOOR INSTITUTE

TEXAS VITRIFIED PIPE CO. W.S. DICKEY CLAY MFG. CO. AYER-McCAREL-REAGAN CLAY CO. NATIONAL FIREPROOFING CORP. BOWERSTON SHALE CO. POMONA TERRA-COTTA CO.  
Mineral Wells, Tex. Kansas City 6, Mo. Brazil, Ind. Pittsburgh 12, Pa. Bowerston, Ohio Pomona, N. C.

When you need special information—consult READERS' SERVICE DEPT. on pages 69-73.

# Engineering Facts about Johns-Manville TRANSITE PRESSURE PIPE Installation Economies

SINCE the cost of installing the transmission and distribution lines may represent as much as 30 per cent of the total original investment in a water supply system, it is important that these costs be kept to a minimum. Transite® Pressure Pipe offers a combination of installation advantages which have resulted in substantial economies wherever this pipe has been used.

These installation economies start when a Transite Pipe shipment is received. Because Transite is relatively light in weight, unloading and all subsequent handling operations are simplified. More footage can be handled per truckload, trucking costs are lower, and distribution on the job site is easier and more quickly accomplished.

Mechanical handling equipment is not usually necessary except where the larger diameters of pipe are used. The sections of pipe are



In this Transite installation at Long Beach, California, the pipe was laid as fast as the trench was opened. Not more than two newly laid lengths of pipe were ever exposed at one time.

easily lowered into the trench, either by hand or with the aid of rope slings.

Transite's factory-made Simplex Couplings provide a number of additional installation economies.

Consisting of only three simple parts, this coupling is rapidly assembled to provide a tight, yet flexible joint. A coupling puller is the only tool required for assembly. So rapidly can the pipe be assembled in the trench that the same foreman often supervises both excavation and installation. And this speed of assembly means that trenches need be open only a minimum length of time.

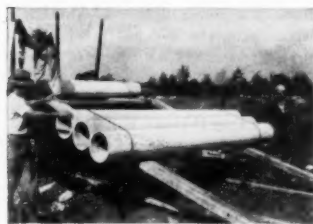
Each joint, moreover, is readily checked for correct assembly as the

pipe is laid. This provides advance assurance that the line will meet final test requirements and is a further help in expediting completion of the job.

The flexibility of the Transite Simplex Coupling affords another advantage. It permits deflections up to 5° at each joint, thereby allowing the pipe to be laid around wide curves and across hilly terrain without the use of special fittings.

The workability of this pipe is also a contributing factor to its economy of installation. Transite is adapted to standard water works practice and is readily connected to valves, fittings, hydrants, etc. It is tapped and drilled with standard equipment. The threads are sharp, clean and strong—connections are tight and lasting. Conventional methods are used for making large service connections.

For further details about Transite Pressure Pipe, write Johns-Manville, Box 290, New York 16, N. Y.



All but the larger diameters of Transite Pipe are unloaded without mechanical equipment and lowered into the trench with slings. Lightness, ease of handling and ready workability contribute to Transite Pressure Pipe's many desirable installation advantages.



Assembling Simplex Couplings is a quick operation. And each joint can be easily checked for proper assembly when it is made, providing advance assurance that the line will meet final test requirements.

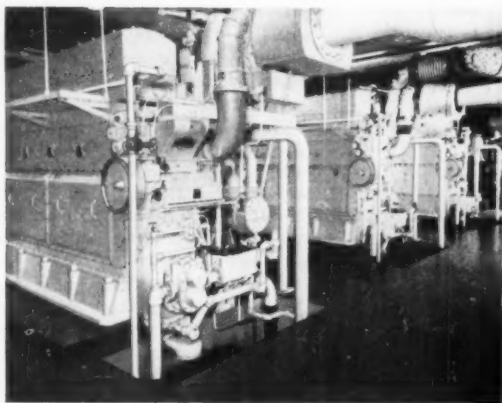
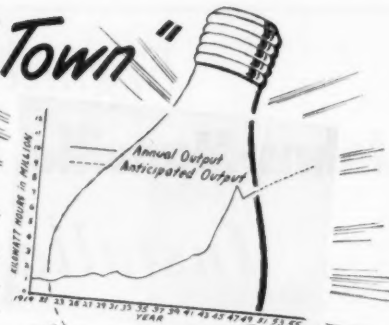
\*Transite is a Johns-Manville registered Trade Mark



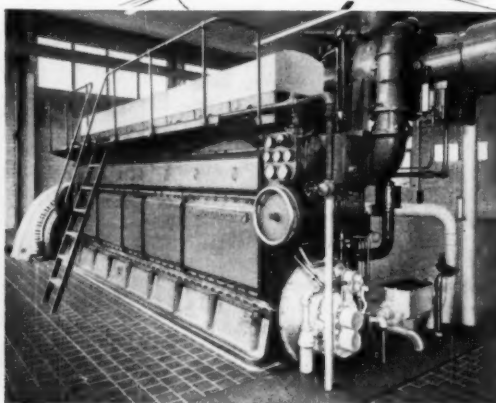


# IOWA'S "Best Lighted Town"

## SETS A PATTERN FOR SUCCESSFUL POWER PLANT EXPANSION



Three of Waverly, Iowa's earlier Worthington Diesels after conversion to supercharging.



Latest Worthington installation in the Waverly Municipal Power Plant. A new Type SEH-8 Supercharged Diesel.

Boasting one of the country's most modern municipal power plants, Waverly, Iowa, has long depended on Worthington Diesels to meet its ever-increasing demands for electric power.

Back in 1938 Waverly installed its first Worthington Diesels, a D-5 and two EE-5's, adding an EE-8 in 1941. During 1947-1948, the speed of the three EE-5's was stepped up from 327 to 360 rpm, and they were supercharged — increasing each engine's output 65%!

Still more capacity was provided in 1949, when a Worthington SEH-8 (Supercharged) was placed in operation, climaxing the Iowa city's eleven-year record of complete satis-

faction with its Worthington Diesel equipment. The economy achieved by conversion to supercharging is strikingly proved by latest figures, which show 11.1% gain in kw hrs per gallon of fuel over the pre-supercharged period. And Waverly reports particularly gratifying results from its converted EE-8 and latest SEH-8. During the year ending March 31, 1949, the former produced 14.48 and the latter 14.42 kw hrs per gallon, at engine

running capacity factors of 59.2% and 45.6% respectively.

### Plan On Lower Cost Power

Far-sighted communities everywhere are profiting by the very real economies of Worthington Diesel performance in power, light and sewage disposal programs. Further facts proving there's more worth in Worthington will aid your own planning. Write to Worthington Pump and Machinery Corporation, Engine Division, Buffalo, N. Y.

# WORTHINGTON



ES-2

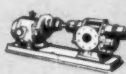
**YOUR  
PARTNER  
IN  
POWER  
PROGRESS**

### WORTHINGTON-BUILT AUXILIARIES

Diesel engines, 150 to 3,520 hp... gas engines, 175 to 3,520 hp... dual fuel engines, 225 to 3,290 hp.



Balanced Angle Compressors



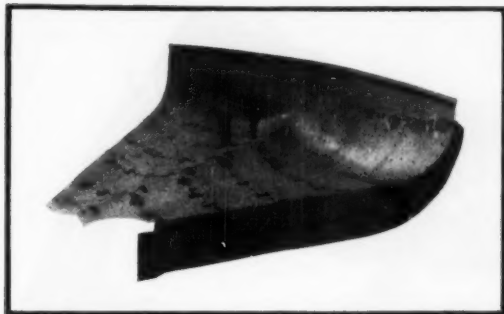
Oil Transfer Pumps



Cooling Water Circulating Pumps



Evaporative Type Engine Water Cooler



## Pumping Costs are **LOWER** with this **HORTON\*** Radial-Cone Design

**Here's the Reason:** The radial-cone bottom — an exclusive patented Horton design of elevated tank — reduces pumping costs because it provides a low range in head. This design enables us to build economically elevated tanks that have a large diameter. Because the diameter is large, the depth needed to hold a given volume is less in the Horton radial-cone bottom design — and that means low range in head between the high and low water levels in the tank. Costs for power go down because the pumps operate against a lower average head.

**Here's the Construction:** Radial girders (one is clearly seen in the foreground of the above illustration) support each sector of the bottom. The plates of the bottom sections between the girders are dished to a relatively long radius. This places them in tension and they carry the weight of the water in the tank without additional supports under them.

**Here are Other Benefits:** Uniform water pressure even during peak loads; adequate reserve supply during power failure; increased capacity of water system; and lower fire insurance rates.

The radial-cone design is particularly adapted for use in building tanks of large capacity. It is available in standard sizes from 500,000 to 3,000,000 gals. Why not let our engineers show you how this *exclusive* feature can lower your pumping costs? There's no obligation. Address our nearest office listed below.

\*Trademark registered in the U. S. Patent Office



Right: 1,000,000-gal. Horton radial-cone tank is installed at Salisbury, North Carolina. It is 140 ft. to bottom and has a 25-ft. range in head between the upper and lower water levels in the tank.

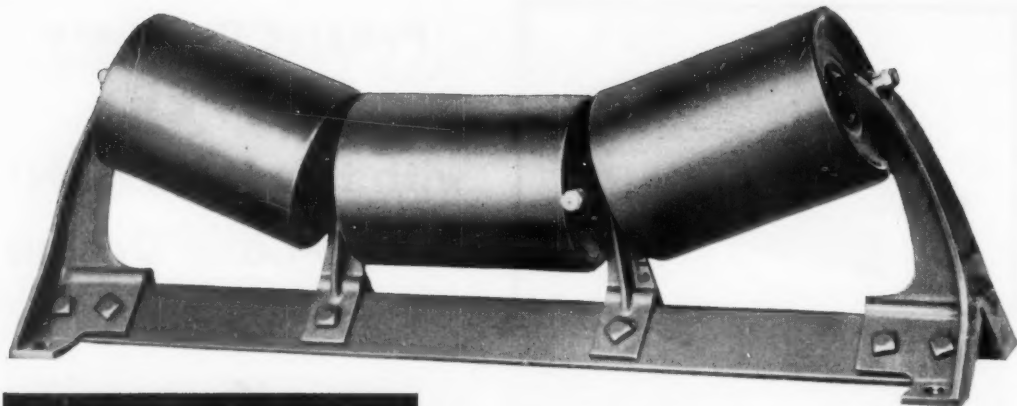
# HORTON

STEEL STORAGE TANKS  
...for municipal service

## CHICAGO BRIDGE & IRON COMPANY

Plants in Birmingham, Chicago, Salt Lake City, and Greenville, Pa.

Atlanta 3.....2123 Hooley Bldg.	Los Angeles 14...1508 General Petroleum Bldg.
Birmingham 1.....1532 North Fifth St.	New York 6.....3314-165 Broadway Bldg.
Boston 10.....1008-201 Devonshire St.	Philadelphia 3.....1648-1700 Walnut St. Bldg.
Chicago 4.....2115 McCormick Bldg.	Salt Lake City 1.....539 West 17th South
Cleveland 15.....2221 Guildhall Bldg.	San Francisco 11...1225-32 Battery St. Bldg.
Detroit 26.....1534 Lafayette Bldg.	Seattle 1.....1309 Henry Bldg.
Houston 2.....2142 National Standard Bldg.	Tulsa 3.....1641 Hunn Bldg.



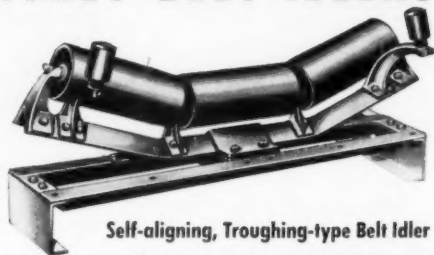
## GIVE IT A RIDE - ON JEFFREY BELT IDLERS

Costs must be cut. No question about that . . . and no question about the economy of Jeffrey Belt Conveyors when small or large quantities of material must be handled. We can furnish them by the rod, or mile, just as the job requires. We know how to provide for reliability under tough conditions, handling of peak loads, low investment, high salvage and other things which are problems peculiar to engineering.

Hence, we say, "Give That Material A Ride on Jeffrey Idlers." They are the backbone of the belt conveyor . . . have been the choice of smart operators on thousands of jobs. They are built to take day-after-day punishment . . . have that reserve strength and durability that count for many years of satisfactory, efficient trouble-free service.

Whether yardage looms large in the estimate, or small capacity is desired, Jeffrey engineers are skilled in the application of material handling to most any job. We would like to talk things over—constructively.

**Catalog No. 785 Tells All**



**Self-aligning, Troughing-type Belt Idler**

Pivotedly mounted on a supporting cross member, guide rollers are mounted on arms and extend at right angles to idler. Need only to be spaced about 20 to 50 feet apart to keep belt in perfect alignment. Will not damage belt.



**Pivoted-type Return Idler**

Used for both troughing and flat belt conveyors. Of the self-aligning, two-pulley type. Also standard return rolls pivotedly mounted in ball bearings on supporting cross member. Write for full details about Jeffrey idlers for either troughing or flat belt service.

# THE JEFFREY

**MANUFACTURING COMPANY** Established 1877

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Baltimore 2  
Birmingham 3  
Boston 16  
Buffalo 2

Chicago 1  
Cincinnati 2  
Cleveland 13  
Denver 2

Detroit 13  
Harlan  
Houston 5  
Huntington 19

Jacksonville 2  
Milwaukee 2  
New York 7  
Philadelphia 3

Pittsburgh 22  
St. Louis 1  
Salt Lake City 1  
Scranton 3

Jeffrey Mfg. Co., Ltd., Head Office & Works: Montreal

When you need special information—consult READERS' SERVICE DEPT. on pages 69-73.

Complete Line of  
Material Handling,  
Processing and  
Mining Equipment





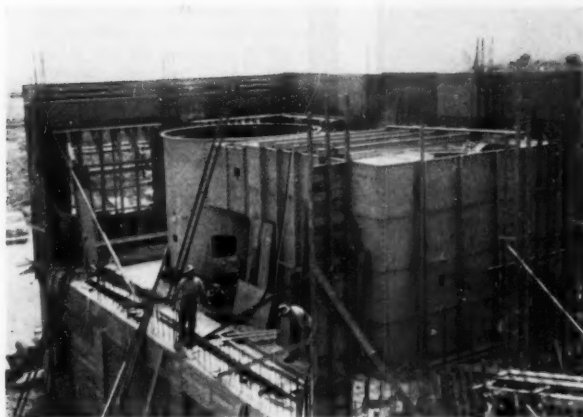
## PUBLIC WORKS

## MAGAZINE

JANUARY 1950



VOLUME 81 • NO. 1



# MECHANICALLY STOKED INCINERATOR *for Alhambra's Wastes*

LINNE C. LARSON

Taylor & Taylor, Consulting Engineers,  
Los Angeles, Calif.

**C**OLLECTION and disposal of the wastes in Alhambra, Calif., are provided for by city ordinances, as follows: The city collects all combustible waste from residential areas; all non-combustible wastes from residential and commercial areas; and all garbage. Other collections are made by private contractors. Garbage is collected by the city twice a week; other waste material is collected once a month.

The method of disposal is as follows: All combustible waste is delivered to the city incinerator. All non-combustible waste is placed on a dump, tin cans and bottles being salvaged by a private contractor. All

garbage is delivered to the garbage transfer station where it is received by a private contractor, under city regulation, and hauled daily to a hog farm.

The area of the city is 7.04 sq. miles and the estimated population is 51,338. Thirty-five years ago, when the population was 5,500, an incinerator was constructed on the east side of the city, where a wash afforded a sloped bank. This site permitted economical construction and was adjacent to a low area where the ashes could be disposed of economically. Due to the large increase in population, the incinerator some years ago became unable to burn all the combustible material produced. Deliveries now amount to 80 tons per day and it has been necessary to operate an open fire dump on which about 60 tons of refuse is burned daily.

### Advantages of Incineration

Open fire dumps are one of the important sources of smoke in the Los Angeles area. Lack of suitable sites limit the use of sanitary fills and precluded consideration of this method for Alhambra.

A proposal for \$225,000 bonds to finance construction of a 150-ton incinerator was defeated in 1946, along with a number of other improvements. The proposal was resubmitted in 1947 and approved. Taylor and Taylor of Los Angeles were employed as consulting engineers. Their first job was to determine the most favorable location for the incinerator. Three sites were considered. These were evaluated on the basis of the number of trucks required; the number of truck trips per collection day; the weighted average hauling distance; the miles



● STEEL stack with brick lining is being erected. The stack is 125 ft. high and 6 ft. inside top diameter. Substitution of steel for concrete reduced cost. View shows rear of the plant.

per year per truck; the cost of labor, truck operation and truck investment; and the cost of ash removal hauling. This analysis, which assumed that in all cases, ash would be hauled to the present city dump, showed an advantage for the present incinerator site.

The costs for an incinerator having a capacity of 150 tons per 24 hours were computed to be \$1.16 per ton for operation and \$0.65 per ton for annual fixed charges, a total of \$1.81 per ton for the present site, as compared to \$2.04 for each of the other sites under consideration. The combined costs of collection and operation, plus fixed charges, were estimated at \$5.03 per ton for the present site, compared to \$5.42 and \$5.46 for the other sites. Cheaper ash disposal and more favorable topography for construction were the principal factors in favor of this location.

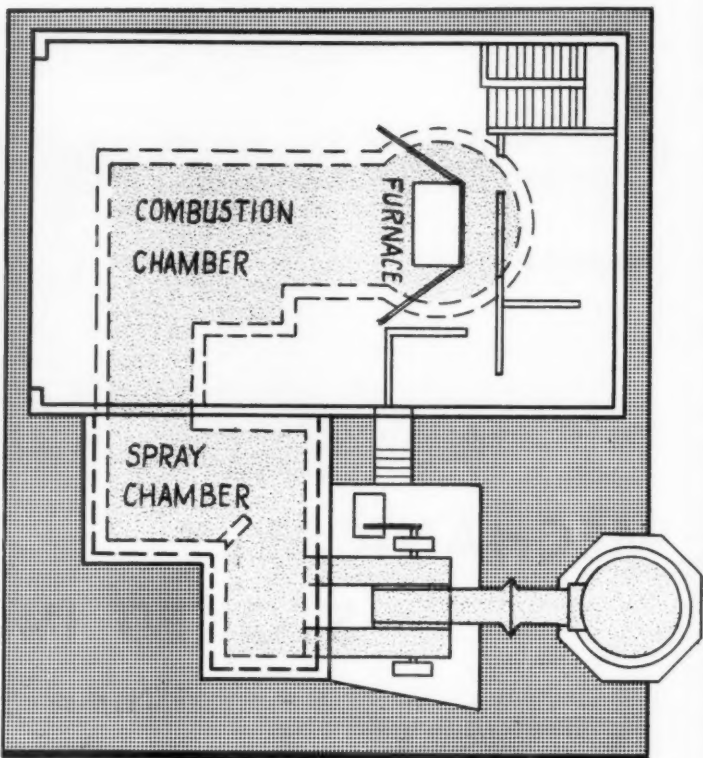
#### Recommendations of the Engineers

The consultants therefore recommended: (1) Use of the present site; (2) specifications to provide truly competitive bidding; (3) adequate guarantees by the contractor covering cost of operation and smoke, ash and odor control; (4) a basis for design for mixed refuse consisting of 20% unwrapped garbage and 80%

refuse; and (5) gravity handling of ash, made possible by the two-level topography as the recommended site.

These recommendations were approved and the 20-year bonds were offered at a coupon interest rate of 2¼%. These were sold with a pre-

neering and Research Corporation of New York, specifying the installation of a Nichols monohearth mechanically-stoked incinerator, submitted a low bid of \$239,800 for the one-furnace plant. The Nichols proposal also submitted the lowest guaranteed maintenance and opera-



● PLAN OF the incinerator building. The furnace, combustion chamber and spray chamber, on the lower floor, are shown in broken lines. Office and toilet, locker and shower rooms are at the right end of the building. Motors, duct, fan and chimney are shown at lower right.

mium which reduced the net interest rate to 2.05%.

Alternates were provided for either a one-furnace plant of 150-ton capacity in 24-hours, or a plant with two 75-ton units. Specifications covered the usual items of furnace chamber volume, combustion chamber volume, ash hoppers, gas passages and velocities, clearances, chimney, and plant facilities. Operational guarantees were required covering smoke and ash discharge from the chimney, temperature, and operating efficiency. Bids were opened in late 1948. Three bids were received. The Nichols Engi-

tion cost specifying that this cost will not exceed \$0.63 per ton during the first year for the incineration of the specific refuse. The bid specified completion in 350 calendar days.

The bond issue also included funds to construct a new garbage transfer station in addition to the incinerator. In order to assure the financing of this garbage transfer station it was deemed advisable to make certain changes in the incinerator which in no way lessen its efficiency. By mutual agreement between the low bidder and the City a steel stack, brick-lined, was substituted for the concrete brick-lined stack as orig-



inally specified and a canopy at the building entrance was eliminated. This substitution and elimination reduced the low bid to \$227,700.

### **The New Incinerator**

The new incinerator plant will have three stories—the upper or charging floor; the second or stoking floor; and the ash room floor. The charging floor is designed so trucks can back into the plant and discharge either directly into the furnace or onto the floor, allowing the truck to unload immediately if the furnace is full. A rubber-tired tractor with a pusher blade then will charge the furnace through a 4' x 7' opening in the top of furnace. A refractory-lined door mounted on wheels and tracks will cover the opening. The door is motor-operated and controlled from a push-button station located on the charging floor.

The furnace will contain a mechanically-stoked unit designed to incinerate 150 tons of rubbish each 24 hours. This will be contained in a vertical cylinder 15 feet in outside diameter, with 9 ins. of fire brick and 4½ inches of insulation encased in a 3/16-inch shell. Total area of the furnace inside the brick wall will be 125.5 square feet and, at rated capacity, this results in a combined drying and burning rate of about 100 lbs. per square foot of area per hour.

The furnace will discharge its combustion products through a combustion chamber, and a spray chamber to remove the fly-ash. The spray chamber will be equipped with water sprays automatically-controlled with modulating valve operated by a pyrometer to maintain a temperature of approximately 600°F. as the gases leave the spray chamber. To overcome the loss through the spray chamber the incinerator unit will have an induced draft fan of 55,000-CFM capacity at 600°F driven by a 25-hp variable speed motor. The fan will discharge into a steel, brick-lined stack with an inside diameter of 6 ft. at the top and 125 feet high above the grates. The combustion chamber volume inside the walls will be 2,250 cubic feet, equivalent to 15 cubic feet per ton of refuse burned per 24 hours. The furnace will be provided with a forced-draft fan driven by a 5-hp motor to provide air for combustion.

Ashes from the furnace will be dumped into ash hopper located beneath the unit. The slopes of the ash hopper will be such as to result in easy discharge of the ash and furnace residue directly into trucks. The ash hopper will be provided

with a hand-operated gate, designed so that it can be readily operated by one man, and will be provided with ash quenching sprays installed to permit thorough quenching of the ash.

Fly-ash and dust from the combustion chamber, flues and spray chamber will be discharged directly into trucks through two ports in the floor of the combustion chamber.

The following instruments will be installed: One recording pyrometer in the office on the charging floor to record the temperature in the combustion chamber, one indicating

pyrometer to show the temperature in the combustion chamber, and another to indicate the temperature in the chimney, and one draft gauge to measure the draft in the combustion chamber. The indicating pyrometers and the draft gauge are on a panel in the operating room. A communication system will be provided between the operating floor and charging floor so that charging of the furnace can be coordinated properly with the operation of the furnace.

The operator will be able to control the Monohearth furnace, forced-draft fan, and induced-draft fan by using push-button stations located conveniently on the operating floor. W. M. Jarrett, City Engineer of Alhambra, is in responsible charge of the incinerator project and reports directly to E. A. Ingham, City Manager of Alhambra. The Nichols Engineering & Research Corporation are the general contractors and are responsible for the detailed design of the incinerator plant. The Nichols Company is represented by Paul C. Rich, West Coast Representative, and E. V. Tait, Construction Superintendent. Taylor and Taylor, Consulting Engineers, Los Angeles, California, under whose directions the preliminary site investigation, and contract documents were prepared, and who are supervising the construction, are represented by the author.



● COMPLETED incinerator structure, ready for work, as viewed from the rear. Ash is removed through door at lowest level

# How a DIFFICULT DRAINAGE PROBLEM was Solved

*This article was sent us by George E. Bean, City Manager of Pontiac. The technical information was furnished by the office of the City Engineer, Lewis M. Wrenn. Robert O. Wright, Administrative Assistant to Mr. Bean, prepared the data for publication. The photographs were taken by the Engineering Department and the way was prepared by the Planning Department.*

A VERY difficult drainage problem, due principally to two related factors, faced the City of Pontiac. The rapid expansion of industrial plants since 1920 resulted in a need for more and better storm and sanitary sewer drainage. This was true around the plants as well as in the newly-built-up residential areas. Combined with this need was the limited tax resources of the 30's which prevented the construction of necessary drainage. Financial limitations were much more serious in Pontiac during this period than in many other cities, primarily because Pontiac is a one-industry (General Motors) town where the main product (Pontiac automobiles) is somewhat of a luxury item. During the depression years the unemployed residents could not pay for the necessary storm drainage, even under liberal WPA or PWA programs. Thus, the engineering plans of the 20's were not put into construction. A third factor was also present. The unavailability of materials during the war prevented construction in the early 40's and the post-war period was reached with a much aggravated need for better storm drainage.

One of the most needed drains was the District "C" Storm Sewer which now provides adequate outlet for a large industrial and residential drainage area on the north side of

Pontiac. This drain also diverts about 80% of the flow from Harris Lake, discharging it directly into the Clinton River, 1½ miles downstream from the point where Pontiac Creek enters the River. Water from Harris Lake otherwise follows a meandering course through Terry Lake, Osmun Lake, and Pontiac Creek, into the Clinton River. Diversion of some of the flow from Harris Lake relieved flooding conditions along the lower meandering course of Pontiac Creek by eliminating 37% of its flow volume through the downtown area.

## Unknown Factors in the Project

The unknown factors about the proposed construction made it the most interesting construction project of the year. The new 84" storm drain was to connect an 84" storm outlet from a combined sewer with a 102" storm drain that discharged directly into the Clinton River. The District "C" Storm Sewer was to cross an area which was soft and swampy, but the exact ground conditions were unknown. Due to the boggy conditions, it was thought that the entire length of 2,433 feet would need a concrete cradle. Piling was also expected to be necessary along certain sections, but it was not known how much piling would be needed.

After all of the preliminary legal

procedures, the bid of the Fattore Company of Centerline, Michigan was accepted for \$109,583.50. The contract was signed March 8, 1948, for the work to be completed by October 1, 1948. Due to extra quantities of piling and concrete used in construction, the total amount paid to the contractor was \$142,410.45 with an additional \$2,457.01 added to the cost of the job for city expenses. The full costs of construction were assessed against the benefited property owners in the area drained. The average 50' x 120' lot paid about \$22.00 for the improvement.

## Equipment and Materials

Reinforced concrete pipe was furnished by Lytell and Colgrove at Clarkston, Michigan. The supporting cradle required 1,816 cubic yards of concrete of the following proportions: 1 part cement, 3 parts sand, and 6 parts gravel. There were 9,080



● DRIVING piles for 84-inch sewer.

lineal feet of timber piling driven to grade with a minimum diameter of 8 inches.

Equipment included 2 Northwest machines, 1 small Koehring, 1 transit-mix truck, and 1 pile driving outfit with a Vulcan #2 single action hammer, driven by a Worthington diesel-powered air compressor. Sand points and a pump were rented from a Chicago firm for \$2000 for use as needed wherever test borings showed a mixture of sand and water.

At the beginning of the job, a Northwest equipped with a backhoe was used at the manhole connection into the 102" sewer. Here the grade line was 22' below the surface. The other Northwest was equipped with a clamshell bucket to clean out the bottom of the trench for the concrete cradle. Walers (8" x 8" x 16")

The pipe was laid by either of the Northwests using a cable inserted through a small hole in the top of the pipe and secured with a pin. Sometimes the dragline used for excavating and sometimes the clamshell used for grading would be used to lay the pipe.

A cone-shaped concrete bucket with a bottom opening was used to put the concrete in place around the pipe. Transitmix trucks dumped concrete into the hopper which was then swung over the excavation with the Koehring crane. The cradle was poured up to the one-quarter line on the pipe along most of the sewer's length. Backfilling was done with a bulldozer and a dragline, being careful to keep the machines off the top of the pipe.

The concrete cradle was laid on a



● **Laying the pipe; stabilization and fine grading in foreground.**



● **CONCRETE bucket, handled by crane, is placing concrete in trench bottom to support the 84-inch storm sewer shown in rear.**

were used to brace the sheeting (2" x 10" x 16') for the first twenty-five feet of excavation.

The first sections of pipe were short lengths laid on a 30' radius with joint forms built and joints poured by the contractor, extra care being taken to see that the joints were properly sealed. The ditch was too wide for normal use of batter boards so after the grade was established at the manhole, a white cord was stretched between poles 22' above grade, thereby permitting the use of a 22' pole to establish the grade of the pipe. Variations from grade were not more than 2" either way. The 30' radius gradually blended into a 300' radius.

clay bottom except where piling was required or where a sand and gravel mixture proved suitable. Suitable clay was found along 1,008 feet of the line; piling was used along 1,051 feet; and a sand and gravel base was necessary for 375 feet. In a few instances the clay was covered with 4 to 5 feet of gray marl and black peat immediately below the flow line. Where possible, this 4 to 5 feet of unsuitable material was removed down to the clay base, and the section backfilled with the concrete cradle material. It seemed cheaper to do this than resort to piling, which was necessary for the sections where the depth to good soil was greater.

At first 30' piling was tried but good bearing (35,000 lbs.) was later obtained with 20' piling. After piling was used for a distance of 375 feet, the clay stratum again came up to within 2' below the flow line, thus permitting the 2' concrete cradle called for in the specifications. Where the clay rose to one foot above the flowline, a cradle only 8" deep was permitted by the inspector.

At another point it appeared piling might be necessary, but after the contractor drained the area, clay was found only 3' below the flowline.

At about the middle of the sewer line the clay stratum disappeared and we encountered sand and water. It had been thought that this section of ground would require the use of sand points and would be the most expensive section to handle. However, when the trench was opened, water was easily kept under control with pumps and the bottom turned out to be sand and gravel, providing a good base for the cradle.

After 300 feet of the sand and gravel formation, a clay bottom was again found. Where the pipe crossed Nelson Street the cradle was poured up to the spring line of the pipe, giving complete support to the bottom half of the pipe at a point where it was just below the pavement. The last 600 feet of pipe again required 30' piling when the firm clay disappeared.

It can be stated without reservation that the size of the project plus the uncertainties of ground conditions made the construction of the District "C" Storm Sewer the most interesting job of the year.

# WINTER MAINTENANCE IN THE NATION'S CAPITAL

## WILLIAM A. XANTEN

Superintendent, Division of Sanitation,

District of Columbia

**E**XCEPT for a few special jobs like clearing the streets for a President's inaugural celebration, I shouldn't imagine that the Nation's capital has any more or any less snow and ice control problems than other cities of comparable size within the snow belt. However, I do believe that our program is unique in several ways and may, therefore, be of interest to others in the business.

In discussing Washington's winter maintenance it is well to start with the organization of the city's forces. They include the Division of Sanitation, Highway Department, Sewer Division and Water Department, plus a considerable number of extra laborers and hired trucks. In addition, the local transit company operates an important sanding program over its bus routes, and the U. S. Park Service maintains a force for the sanding of roads within park areas.

### Cost of the Program

Expenditures in the city under this program, depending on the severity of the winter, can vary from \$50,000 to \$300,000 or more annually, based on the limitation of available funds. The major cost of the snow program is for the spreading of abrasives and the hauling of snow from business streets, principally in the heart of the downtown area, but including several outlying business districts, bridges, and important intersections.

Before elaborating upon our snow and ice control methods, I would like to review two very important changes that we have brought about.



First, we have installed a new system of dealing with conditions during a rush-hour period. We now send special crews at once to the troubled spots, ignoring temporarily less important locations. We have found these tactics to be a great improvement over our older methods. Secondly, we in the Department are convinced that good sanding units are prerequisites to successful ice control. Two years ago we added several truck type spreaders to our fleet. They require but one man and cover twice as much highway as does the old unit that called for a driver and two laborers. This new equipment has provided cheaper and speedier coverage, and from the standpoint of quick mobilization is greatly superior.



Just what kind of a problem do we have here in Washington? Well, snow, sleet or freezing rain falls on the average of 20 times a year. About three snows are of a depth greater than 3 inches, and the average annual snowfall is 20.5 inches. For the coming winter we will have the following equipment and labor available, not including supervisory and mechanical forces:

DC forces, 160 plows, 37 sanders, 4 rotary loaders, 26 bucket type loaders, 1 crane loader, 1 belt type loader, 277 trucks, 8 graders, 3 tractors and jeeps for sidewalks, 353 drivers and 1,310 laborers.

Other forces: Capital Transit Co., 21 plows, 28 sanders, 4 bucket type loaders, 33 trucks and 25 drivers, and 80 laborers. National Capital Parks, 19 plows, 13 sanders, 1 rotary loader, 28 trucks, 1 grader, 5 tractor or jeep plows for sidewalks, 40 drivers and 215 laborers.

This gives a total force of 200 snow plows, 78 sanders, 37 loaders of various types, 338 trucks, 8 sidewalk plows, 428 drivers and 1,605 laborers.

All components listed operate under a master plan, each handling its own responsibilities.

### The Plowing Program

The plowing program is confined to approximately 342 miles of arterial and heavily travelled streets. In the event of a 10-inch

● **STOCKPILE** of abrasives is being treated with calcium chloride to prevent freezing and increase efficiency.



snow falling at the rate of 1 inch per hour, and based on the estimate that each route is covered once every two hours, it would be necessary for the plows to travel an aggregate of 12,500 miles during the 10-hour period of the snowfall in order to keep open the entire width of the 342 miles of street.

An emergency plowing program of snows more than 12 inches deep is confined to 122 miles of arterial highways. This program is set up in the event of a heavy snow, and all available plowing equipment will be concentrated on these particular highways to attempt to keep the roadways open for emergency vehicles to provide coal, fuel oil, food, medical treatment, etc., to residents of the District. Heavy windrows at important intersections are given special attention.

The complete removal of snow by



● **SELF-HELP containers are located at numerous points in city.**

ing snow from crosswalks, catch basins and fire hydrants; and clearing and hauling of snow from important intersections, bridges, etc.

Sanding equipment proceeds over scheduled routes of streets selected

to keep them from freezing in stock-piles and to help embed them on the surface of the ice. Calcium chloride works quickly at low temperatures and keeps the sand from being swept off the road by wind and traffic. Calcium chloride is also used straight on some of the Capital's more important bridges. Rock salt is also used in direct application on some streets. We must exercise care in the use of straight chemicals because of our underground third rail streetcar transit system. If chemicals are applied too near the lines, short-circuiting will result. This handicaps us greatly since it prevents the use of chemicals in the heart of the city and at many critical intersections.

### 200,000 Parked Cars

Our greatest obstacle toward doing a really effective job of snow and ice control is parked cars. Wash-



● **PLOWING to the curb, possible when there are no parked cars, widens the travelable way.**



● **PARKED cars on main streets make plowing difficult and complicate snow removal.**

loading and hauling in trucks (and disposing of it into sewer manholes and in the Potomac) is confined to some 33 miles of streets in the downtown and outlying business districts. By the use of all available District labor and equipment, supplemented with extra labor and trucks, the program contemplates a force consisting of 1300 men, 300 trucks, and available mechanical equipment, working mainly during the traffic-free hours of the night and for a number of shifts, depending upon the severity of the snow storms.

### White Wing Work

As part of the snow hauling program the regular white wing force (numbering some 250 men) is assigned the task of improving the conditions in their respective areas throughout the city by stationing sand crews on important hills; clear-

because of the presence of hills, and the volume of traffic. In recent years the sanding program has been supplemented by placing of some 150 self-help receptacles at strategic points. The receptacles are kept filled with calcium chloride treated abrasives. As stated previously, special sand crews are also stationed on a few of the more critical hills to assist traffic during daylight hours. In addition to scheduled routes, requests for special sanding are responded to as promptly as available forces permit. This request service is maintained 24 hours a day during freezing weather. Two-way radios installed in sanding units last year proved very satisfactory and consideration is being given to expanding the use of radio to other phases of snow work.

All abrasives used by the District are treated with calcium chloride

ington's population has, I think, increased more rapidly than any other city in the country—it has been nearly tripled since the start of the recent war. Many apartments, inadequate housing and the trend toward building garageless homes, have all



Courtesy Good Roads

● **ONE TYPE of sanding equipment used for applying aggregate.**



contributed to a serious parking situation. With some 200,000 cars parked on the streets every night, something had to be done. We partially remedied the problem by prohibiting parking from 2 to 8 A.M. on about 86 miles of streets between December 15th and March 15th. These streets are all plowed to the curb. Without this ban a serious traffic condition would exist following a heavy snow due to the narrowed width of roadway left for traffic after bulky windrows of snow have been placed against automobiles parked at the curb.

In Washington, as in many cities, the weight of the winter maintenance responsibility falls on the Department of Sanitation. This means that during prolonged periods of bad weather, men usually engaged in refuse collection must be diverted to snow and ice control work. The result is obvious: a serious threat to the health of the community. Many of the larger cities of this country have solved this to some extent by contracting out a large portion of the work, with the city's forces serving as a reserve for heavy storms only. We are presently considering following similar steps.

We have by no means overcome all our snow and ice control difficulties. They are complex and not to be solved in one fell swoop; a combination of solutions is needed including public understanding and cooperation of the first order. It is doubtful whether the task will ever

be accomplished to the satisfaction of the public as a whole. In large urban areas under present-day traffic conditions the infrequent but inevitable heavy snow fall cannot help but cause chaotic conditions; particularly in latitudes where the large expenditures for a reasonably sufficient fleet of snow equipment are difficult to justify. The subject is one which is currently receiving much attention. It deserves the fullest consideration of all concerned branches of local Government as well as public understanding of the vital need for cooperation during such periods of emergency.

### How Hays Eliminates Filter Fly Trouble

Hays, Kansas, operates two 90-ft. sprinkling filters at its sewage treatment plant and experiences the not-unusual problem of flies. The operator, Roy Binder, said, in a paper before the Kansas Sewage Works Association: "Several methods have been tried to get rid of them, some more effective than others. Burning with an air-pressure blow torch, as well as dosing with kerosene, creosote, chlorine, and ammonia proved comparatively ineffective.

"Spraying with DDT is the method now used, the dosage being 4 gal. of 5% solution, made up by diluting 1 gal. of 20% concentrate with 3 gal. of water. Every attempt is made to reach all the breeding places at each

spraying. Near the end of April, June and August, the weeds around the filters are mowed, then the flow in the distributor arms is cut off. Using a power sprayer, two men, each with 50 ft. of hose and a fan-shaped nozzle, spray the stone, the distributor arms, the inside wall, the outside wall to the runoff point, and the weeds around the filter for a distance of 15 to 20 ft. With this procedure, fly troubles have been eliminated."

### Tachographs On City Refuse Trucks

JOHN HUBEL

IN 1948 the Department of Public Works, Milwaukee, Wis., decided to try out a tachograph on one of the garbage trucks, so that, at the end of the day, the number of stops for garbage collection could be determined, as well as the length of each stop. Complaints had been received of "soldiering" on the job from several sources. One alderman told of a rendezvous held by crews at some points for "at the curb discussions." When the tachometer was checked, it was said to show a 40 minute stop at one house, although garbage collection from one two-story house should not take more than ten to fifteen minutes at the most, as containers are kept near the alley. One city official says unauthorized delays cost the city about 30% more than if collections were more efficient.

During the experiment, the men complained about being checked up on so carefully, and, as a strike of crews was imminent at that time, the tachometer was taken off and all was well again. However, since that time many complaints have been coming in about slow collections of garbage. The council has now decided to put tachographs on all of the city trucks that operate on a schedule, as those for garbage and ash collection, and the union is again objecting to installations of checking devices.

### A Slide Rule for Sewer Design

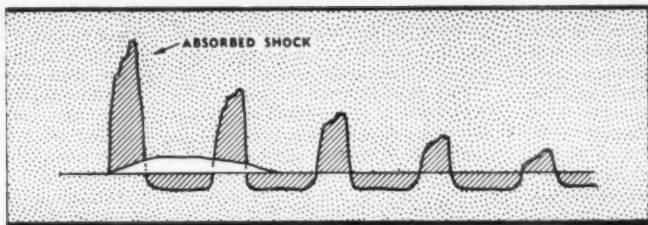
A slide rule which helps greatly in sewer design has been developed by Irving Goldfien, Civil Engineer of the Bureau of Sewers of Milwaukee. It is based on using the Chezy formula and applies only to circular sewers. The rule is 13 in. long and has 10 scales which give almost any desired information with one reading. A "part full" scale is provided for converting full discharge into other depths of flow.

## LEADERS IN THE PUBLIC WORKS FIELD



EARNEST BOYCE

Chairman of the Department of Civil Engineering at the University of Michigan, and Professor of Municipal and Sanitary Engineering, Earnest Boyce has brought to teaching a practical and realistic viewpoint that is refreshing. He is widely known through his long and outstanding service in engineering. He has served in two world wars, with distinction, and with profit to his country. We think the engineering students at Michigan are fortunate.



● **WHITE AREA** shows effect of desurger in reducing water hammer shock and surge in gravity pipe line with quick valve closure.

# How Water Hammer and Pipe Line Surges Can be Controlled

**JOHN HOWARD DAWSON**

Associate Professor of Civil Engineering,  
Oklahoma Institute of Technology,  
Stillwater, Okla.

**H**YDRAULIC shock or "water hammer" keeps right on presenting itself as a first class headache, every time a valve is closed against a moving column of liquid; and the ache increases in direct proportion to the increase in velocity, speed of valve closure and volume and length of the liquid column. Much time and money have been spent to overcome this problem. Possibly the greater portion has been expended in "on-the-job" and "in-the-field" emergency measures; all too often it has involved more than simple remedies. Many times it has occasioned revamping of piping, relief and by-pass valves, air chambers and tanks of impressive capacity and thickness to accommodate these shock loads. Perhaps the most familiar device for decreasing water hammer surges is the open surge tank.

## Water Hammer Problems

Hydraulic shock travels from its point of origin—the suddenly closed valve—up the pipe line through the hydraulic shock that the resulting shock cycles continue with decrease (including water) is completed at an average speed of about 3,560 ft. per second. It is characteristic of fluid column and returns to its point of origin. The cycle in many fluids

ing intensity until finally dissipated, with the fluid brought to rest.

The pressure in a pipe line due to water (or other liquid) hammer is dependent on the weight of the fluid (also its density and elasticity); the size, wall thickness and elasticity of the pipe; and the change in the velocity of the fluid column.

The formula for the pressure generated is:

$$P = \frac{w}{g} V_v (V-v)$$

Where:  $P$  is the additional pressure in pounds per sq. ft. due to water hammer;

$w$  is the weight in pounds per cubic foot of the fluid;

$g$  is the acceleration due to gravity, or 32.2;

$V_v$  is the velocity of the pressure wave in the particular pipe; for most water pipes, this is about 3,560 feet per second.

$V$  is the original velocity in the pipe in feet per second;

$v$  is the velocity in the pipe after the pressure wave has reached the end of the line and has returned.

For most calculations, a simplified formula may be used which gives the additional pressure due to water hammer in pounds per sq. in.

$$P_1 = 48 \times \text{Spec. Grav.} (V-v)$$

More recent research appears to indicate that the constant 48 gives insufficient pressures in many cases, and a sounder value would be probably between 52 and 60.

The time required for the pressure wave to travel to the far end of the line and return is important. If the valve is closed in less time than is required for the travel of this pressure wave, the full theoretical water hammer pressure will be developed.

**Example**—An 8 inch gravity line carries gasoline from a storage tank to a loading rack 1,500 ft. distant. The pressure at the rack is 90 pounds per sq. in. The gasoline, which has a specific gravity of 0.72, is flowing at the rate of 14.1 fps. If the discharge valve is closed in  $\frac{3}{4}$  second, what will be the resulting pressure in the pipe line?

**Solution**—The time required for the pressure wave to travel to the end of the line and return is  $2L \div V_v$ , where  $L$  is the length of the line; or  $2 \times 1,500 \div 3,560 = 0.84$  second. Since the valve is closed in 0.75 second, full water hammer pressure will be developed, and  $P_1$  will equal  $48 \times 0.72 (14.1-0)$  or 487 pounds per sq. in. The maximum pressure at the valve under these conditions will then be  $487 + 90$ , or 577 psi. Actual tests were run on this line when velocities were considerably above the 14.1 ft. per sec. indicated in the example, and maximum pressures as high as 1,350 psi. were registered.

If the valve were so controlled that it would accomplish a uniform reduction in velocity over a space of 5 seconds, the water hammer pressure would be much reduced. The actual pressure can be determined by the relationship between the time of closure, the time required for the pressure wave to travel to the end of the line and return, and the pressure developed with a closure time of 0.84 second or less. Computations will show the excess pressure in the 82 psi and the total pressure in the line to be 172 psi when 5.0 seconds are required to close the valve.

There is nothing new about such calculations. However in this discussion they lead to a completely new approach, not only to the solution of water hammer difficulties,

ample cited above, the maximum pressure due to water hammer without any control was 1,350 psi.; and with the instrument was 90 psi.

This device, which is called the "Fluidynamic Desurger and Shock Absorber," is an instrument which should have a wide application in the water works field.

#### How the Desurger Works

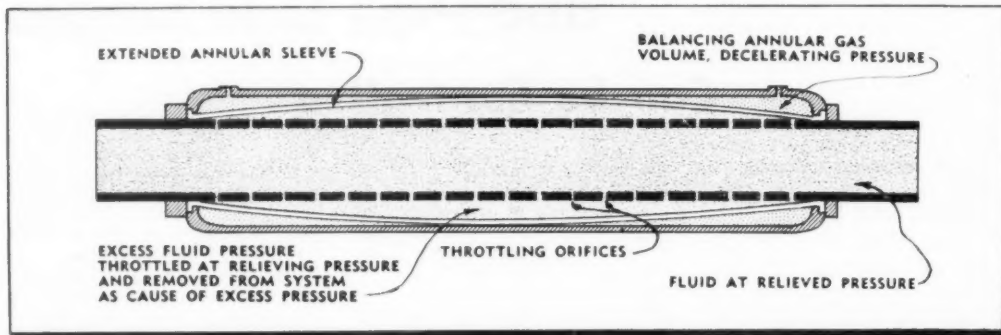
A conventionalized cross-section of the desurger is shown below. The desurger reduces and controls the excess pressures produced by surges or shock, in part by the series of calculated throttling orifices shown in the cross-section. Since the instrument is of through-flow design, this arrangement of orifices reduces shock pressure head in that

previously given, and assuming a quick-closing valve,  $P_1$  would be  $48 \times 1 \times 5$ , or 240 pounds, plus the static line pressure, the specific gravity of water being 1. How much shock pressure would be removed by the desurger, and what would the remaining pressure due to water hammer be?

**Solution.**—The percentage of shock removal would be  $N = 100 - (1.66 \times 5)$ , or 91.7, and the pressure rise due to water hammer would be  $240 \times 0.083$ , or 20 pounds.

Various curves are reproduced herewith. They are from the test results made by the author at the Oklahoma Institute of Technology and show typical performances.

The desurger was installed on a 4-inch line coming off a 6-in. header.



but also to the control of all types of shock waves in moving liquid columns. Two of the more common and disturbing of these—the surges set up under certain conditions by reciprocating and centrifugal pumps—will be discussed later in this article.

An excellent reference on pipe line surges is: "Surge Problems in Pipelines" by S. Logan Kerr, ASME, 1949.

#### Controlling Water Hammer

This new approach to these problems comes in the form of a through-flow instrument which can be applied to any line or system, close to the origin of the trouble. This device, which was tested in our laboratories, suppresses water hammer and removes harmful surges from pipe lines. Tests by our Division of Engineering Research showed that this instrument removed 75% of the shock pressure rise on a quick-closing valve in a 4-inch pipe with a water velocity of 18.5 fps. On the same line, with instantaneous valve closure, 90% to 96% of the shock pressure rise was removed at velocities up to 6.5 fps. In the ex-

#### ● THIS IS A sectional view of the desurger showing its component parts and how it reduces water hammer shock and surge.

portion of the liquid column moving through it. As the excess head or volume moves out of the liquid column through these orifices, it is throttled and a portion of its energy removed. Through this operation, it has extended the annular sleeve which is balanced with relation to the nominal line pressure by loading the annular chamber with gas or air.

When the chamber pressure expels the excess volume back into the line, as the surge pressure falls, the throttling orifices again act to remove another large percentage of its damaging energy. It has been established by our tests that the percentage of shock removed by this instrument for velocities of less than 15 fps may be determined by the following formula:

$$N = 100 - 1.66V$$

where  $N$  is the percentage of shock pressure removed; and  $V$  is the initial velocity in the pipe line before valve closure.

**Example.**—The velocity in a water pipe line is 5 fps. Using the formula

Line pressure with no flow was maintained between 25 and 30 psi. The valve used was of the quick-closing plug type, manually operated, with an estimated closure time of 0.1 second. In addition to several visual Bourdon type gages, readings and indicator cards were obtained by a cantilever type Bacharach engine indicator with a 400-lb./in. spring. Average velocity in the 4-inch test line was increased by 1 fps increments and at each velocity measurements of pressure were made both with and without the desurger.

During our tests an incident occurred which illustrates how shock pressure rises. The lubricated plug valve was closed instantaneously. The high pressure on the valve resulting from water hammer stripped four and one-half threads from the 4-inch pipe and blew the valve across the floor. The pipe jumped from its resting place; and the foot valve on a 6-inch pump 260 ft. distant was snapped off. Two 300 psi gauges were broken.

This desurger is available in pipe sizes from  $\frac{1}{4}$  in. to 16 in. For lines of extreme length, where it is desirable to reduce the peak surges markedly, several units may be installed either in parallel or in series. Arrangement in parallel permits inspection without shutting off the flow through the line.

#### High-Volume, Low-Cycle Pump Surges

The repetitive surges of the high-volume, low frequency character that are often generated by reciprocating pumps may be troublesome and destructive factors in such pump installations. For testing purposes, the desurger was installed on the discharge side of a reciprocating pump where it acted on the surge or

able, but it was estimated that the surge was decreased to less than 10 psi, or to about 6% of the original. This gives a reduction of 94%. Visual observation of the Bourdon pressure gages used to obtain average pressures indicated a reduction of about 96%. Several runs were made at different pressures and these checked satisfactorily.

#### Low-Volume, High-Cycle Surges

The desurger had another marked effect. At the highest possible speed on the control runs, the pump and attachments vibrated severely and there was much noise. With the desurger on the discharge line, both noise and vibration were greatly reduced.

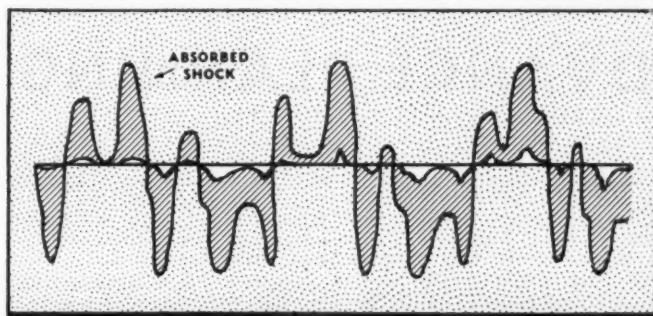
High frequency surges of low am-

plitudes were installed in the test section of the line and a Bacharach engine indicator with a 400-pound spring was used to record pressures. The indicator card for the control run was left in place and another control line, using the desurger, was obtained directly on top of the first line. A Brinell type microscope was used for measuring the magnitude of the fluctuations. With this equipment, distances from center to center of the lines in the paper could be read to one-fiftieth of a millimeter, or to about one pound. Since no fluctuations were observed for speeds up to about 12 cycles per second, when the desurger was in the line, it was assumed that the pressure variation was less than 1 psi. The lowest reliable efficiency measured was 68% at 23 cycles per second. At this speed, because of the excessive vibration of the testing equipment, it was considered advisable to use more substantial testing equipment.

A 6-inch centrifugal pump, with a 6-bladed impeller, operating at 1745 rpm was then used. If each blade of the impeller imparts a surge, there should be 174.5 cycles per second of low amplitude surges in the line. At normal operating speeds, the test equipment on control runs showed a pressure variation of 3.75 psi about twice a second, and 1.25 psi so fast that it could hardly be noted. With the desurger in the line, the largest surges had a magnitude of 0.312 psi, with no minor surges. This indicates a removal of 91.5% of the surges at 174.5 cycles per second. For this work, the most sensitive Bacharach piston type engine indicator was used.

Additional tests have checked one extremely interesting observation made on the reciprocating pump

(Continued on page 68)

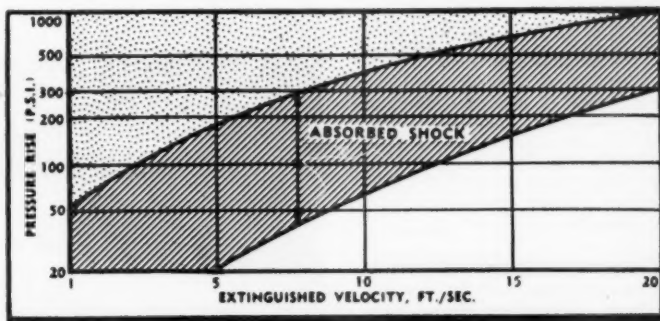


● **SHOCK absorbed by desurger (dark vs. white areas) in low-cycle high-volume surges generated by reciprocating pumps.**

excess head caused by the piston action of the pump and by the opening and closure of the valves in the pump. Our tests indicated that the pump flow, under such conditions, could be smoothed out to a plus or minus 5% of the pressure rises, regardless of their size or frequency.

The test data from our Division of Engineering Research are typical of the pressures produced by 2-cylinder reciprocating pumps of the double acting type. The figure herewith shows the actual surges in a  $4\frac{1}{2}$ " x 6" double acting mud pump with and without the desurger in action on the discharge flow. These surges were obtained by means of a cantilever type Bacharach engine indicator equipped with a 400-pound spring. To obtain the cards shown, some horizontal adjustment of the time axis was necessary in order to superimpose the results. The maximum difference in pressure, without the desurger, was about 170 psi. With the desurger in the discharge line, surge was so reduced that accurate measurements could not be obtained with the instruments avail-

able, are produced by centrifugal, rotary vane and gear pumps. These surges are cyclic and usually sinusoidal in character and, by reflection from pipe bends and fittings, may superimpose, resulting in standing waves resonating at pressures considerably above line pressures. This application of the desurger was investigated. For this test, Bourdon



● **THIS DIAGRAM shows, for a typical case, the absorbed shock in pounds per sq. in. at velocities from 1 to 20 ft. per sec.**



# How to get

## FUNDS

# for PUBLIC WORKS ADVANCE PLANNING

### PERE F. SEWARD

Commissioner, Community Facilities Service  
General Services Administration

**W**ITH regulations and rules completed and approved Administrator of General Services Jess Larson has announced the new Advance Planning Program for non-Federal public works is ready to go.

Reflecting inquiries that have come into the General Services Administration offices since the 81st Congress authorized \$100,000,000 to reactivate the program for two years, 5,000 application forms have been forwarded to the division offices of GSA's Community Facilities Service which will administer the program.

An initial appropriation of \$25,000,000 has been apportioned among the States under a formula fixed by the Act, except for a discretionary fund of \$5,592,529 which is reserved for the Administrator's use in communities where unemployment distress exists or impends. Minimum apportionment to any State is \$90,938. This appropriation is expected to bring needed local public works to cost an estimated \$750,000,000 through blueprint and specifications preparation.

#### Planning Loans Are Available

Planning loans will be available, without interest, to States, cities and counties; school, sanitary, levee, and drainage districts; townships and other political subdivisions. An

advance of 25 per cent of the planning cost will be available immediately as soon as an application for a planning project is approved, with the balance of the loan payable when plans are completed. Each loan is repayable into the U. S. Treasury when building work gets under way, and construction generally is to be started, within three years after plans have been approved.

Among the purposes of the advance planning loans is the encouragement of non-Federal public agencies to maintain a live reserve shelf of fully planned public works projects ready to go into construction should economic conditions make this desirable; and the attainment of a maximum efficiency and economy in the planning and con-

struction of public works. Projects for which GSA approves plan-preparation loans must conform to an over-all state, local or regional plan, where such exists.

The need for school plant facilities in all parts of the country are listed predominantly in the early inquiries from potential participants in the new program. Many types of public works are eligible for planning advances, however, except projects for which Federal funds from other agencies are available.

#### What is Included

Sewer, water and sanitation projects including incinerator plants and malarial control facilities.

Highways, roads, and urban streets; culverts, drainage facilities, sidewalks, curbs and gutters; guard







rails and guard walls, road and street lighting, traffic control facilities, roadside landscaping and other similar work.

Bridges, viaducts, grade separations and grade crossing eliminations, tunnels.

Airports, including terminal and administration buildings and hangars; grading, leveling and seeding of landing fields; construction of runways, aprons, taxi strips; landing platforms, seaplane ramps, drainage and lighting facilities.

Schools and administration buildings, auditoriums, gymnasiums and dormitories; public libraries.

Public hospitals, nurses' homes, clinics, laboratories, health centers and sanitariums.

Non-Federal public buildings such as city and town halls, courthouses, institutional and administrative buildings, police and fire stations, garages and storage buildings.

Parks and other recreational facilities including playgrounds, fairgrounds, athletic fields, gymnasiums and swimming pools.

Miscellaneous public facilities such as transportation and port facilities; public markets; public docks, wharves and piers, and non-Federal river and harbor improvements.

Under the first Advance Planning Program, May 1945—June 1947, 11,216 applications for plan preparation loans amounting to \$113,323,258 were received. Congress had appropriated \$65,000,000. Some applications were withdrawn, others were turned down when the need for the project was not deemed essential or the applicant could not give assurance of ability to finance construction. When the program ended, however, 6,790 public works projects to

cost an estimated \$2,683,914,258 had been approved for planning assistance.

#### Where to Get Assistance in Planning

Applications for planning assistance may be made directly to the Division Engineers of the Community Facilities Service in the following locations:

William D. Jones, 42 Broadway, New York 4, N. Y.—Connecticut, Maine, New Jersey, New Hampshire, New York, Rhode Island, Vermont, Massachusetts.

Henry J. Sullivan, 1729 New York Ave., N. W., Washington, D. C.—Delaware, District of Columbia, Maryland, Ohio, Pennsylvania, Virginia, West Virginia.

Oliver T. Ray, 114 Marietta St., N. W., Atlanta 3, Ga.—Alabama, Florida, Georgia, Mississippi, North Carolina, South Carolina, Tennessee.

Roland C. Ashton, 1122 U. S. Post Office, Chicago 7, Ill.—Illinois, Indiana, Kentucky, Michigan, Wisconsin.

C. W. Anderson, Fidelity Bldg., Kansas City 6, Mo.—Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota.

W. H. Sindt, Texas & Pacific Bldg., Fort Worth 2, Texas—Arkansas, Louisiana, Oklahoma, Texas.

Wright L. Felt, 630 Sansome St., San Francisco 11, Calif.—Arizona, California, Hawaii, Nevada.

L. R. Durkee, 618 Second Ave., Seattle 4, Wash.—Idaho, Montana, Oregon, Washington, Alaska.

Emil Sandquist, U. S. Custom House, Denver 2, Colo.—Colorado, New Mexico, Utah, Wyoming.

#### TOTAL ALLOTMENT TO STATES, PUBLIC WORKS ADVANCE PLANNING

Alabama	384,484	New Hampshire	90,938
Arizona	90,938	New Jersey	564,540
Arkansas	264,446	New Mexico	90,938
California	937,020	New York	1,828,934
Colorado	152,411	North Carolina	484,697
Connecticut	231,891	North Dakota	90,938
Delaware	90,938	Ohio	937,384
Florida	257,535	Oklahoma	317,008
Georgia	423,951	Oregon	147,864
Idaho	90,938	Pennsylvania	1,343,328
Illinois	1,071,607	Rhode Island	96,758
Indiana	465,054	South Carolina	257,717
Iowa	344,471	South Dakota	90,938
Kansas	244,440	Tennessee	395,578
Kentucky	386,121	Texas	870,454
Louisiana	320,828	Utah	90,938
Maine	114,945	Vermont	90,938
Maryland	247,168	Virginia	363,386
Massachusetts	585,819	Washington	235,528
Michigan	713,132	West Virginia	258,081
Minnesota	378,846	Wisconsin	425,769
Mississippi	296,274	Wyoming	90,938
Missouri	513,615	District of Columbia	90,938
Montana	90,938	Alaska	90,938
Nebraska	178,601	Hawaii	90,938
Nevada	90,938	Puerto Rico	253,716

# HOW TWO CITIES

## use CRAWLER TRACTORS

---



The problem of refuse disposal is handled by sanitary fill in Colorado Springs, Colo. The city has an IHC diesel crawler tractor equipped with a bulldozer and a 4-yard rear-dump scraper made by Bucyrus-Erie. This equipment is used to dig a trench about 16 feet deep and 40 feet long, the dirt from the trench being piled at either end. Refuse, including garbage, is dumped at the edge of the trench by the collection vehicles, and then bulldozed into the trench. It is then leveled and compacted by working the tractor-bulldozer unit back and forth over it until a thickness of about 3 feet of compacted refuse is obtained.



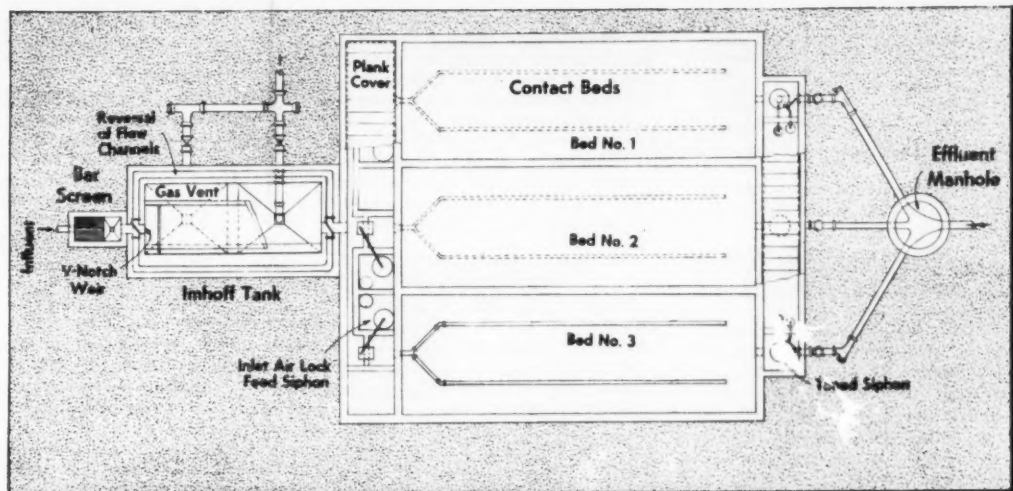
It is then covered with about a foot of compacted dirt which is brought in by the scraper from the stock piles at the end of the trench. This dirt is spread evenly and thoroughly compacted. Another layer of refuse is then spread on top of the compacted and covered layer, and so on until the trench is completely filled. A new trench is then dug. Delivery of refuse is not strictly regulated and private deliveries occasionally result in dump fires. A sprinkler truck is used to control these.



Denver uses an IHC TD-9 diesel crawler tractor, equipped with an Isaacson bulldozer as a general maintenance unit for its waterworks system. This unit is used for trenching, backfilling and general utility work, especially along the irrigation ditches which provide water for farms on the outskirts of the city and feed several of the city park reservoirs.

Another IHC tractor and bulldozer is used by the Denver Department of Public Works for refuse disposal. In general, the same method of ditching, depositing, leveling and covering of the refuse is used as was described above for Colorado Springs.

● The top illustration shows the refuse disposal unit used by Colorado Springs. The two lower illustrations are of the equipment used by Denver.



• A WELL DESIGNED plant for a summer camp where subsurface disposal is impossible.

# SEWAGE TREATMENT for SUMMER CAMPS and HOTELS

**JOHN J. BAFFA,**

Consulting Engineer, New York City

SUMMER camps, boarding houses, summer hotels, country clubs and similar seasonal recreational establishments have increased many-fold in numbers and in size in the past several years. This growth has resulted from the development of many rural areas because of increased summer migration of urban population. As a result, the sanitary facilities of summer recreational areas have acquired increased significance from the public health standpoint. Also, coincident with these conditions has been the passage of pollution control laws by many states. Thus, many of these establishments are subject to more rigid requirements for sewage disposal than has hitherto been the case.

Proper disposal of human and domestic wastes from summer camps and hotels is of extreme importance to prevent contamination: (1) Of

drinking water supplies; (2) of food by insects and rodents which may come in contact with such wastes; (3) of waters used for bathing, fishing or other recreational purposes; and (4) to avoid disagreeable nuisance, odors and unsightliness.

## Economic Considerations

Many camps and hotels are faced with considerable financial outlays for construction and operation of sewage treatment facilities. It is necessary for the designing engineer to make a thorough study of each individual case so that sewage treatment can be provided with maximum economy of construction and operation.

Factors affecting cost include site topography, soil conditions, elevation of the ground water table and treatment requirements. Final choice of type of treatment and plant location should be based on estimates of costs of alternative approved solutions. In cases where more than one building is to be served, it may be necessary to study the relative costs of providing sewers and a central treatment plant as against provid-

ing separate treatment units for each building. Pumping costs, both initial and operating should be evaluated against the cost of deep excavation for gravity conduits. This is particularly important where rock excavation may be necessary.

## Quantity and Quality of Sewage

The population to be served may vary from as few as fifty persons to as much as five hundred or more. The quantity of sewage may vary from 25 gallons per person per day, for outdoor camps with a small number of plumbing fixtures, to 150 gallons per person per day for the larger camps and hotels with numerous fixtures. The best method of determination of sewage flows is by sewer gauging whenever this is possible; while for completely new establishments anticipated flows and their probable variations must be predicted from the population, number and type of fixtures and type of establishment.

In a survey made by PUBLIC WORKS MAGAZINE, the requirements for average design flows of various state sanitary engineers were as follows for summer camps:

Arkansas	30 gpcd.
Connecticut	60 gpcd.
Indiana	100 gpcd.
New York	25 to 75 gpcd.
Montana	50 to 65 gpcd.
Texas	50 to 70 gpcd.

Some hotels may have average flows of as high as 150 gallons per capita per day.

Sewage flow characteristics at camps will differ from municipal flows to the extent that peaks will be higher and variations rapid. Where a central treatment plant is used, the hydraulic capacity should be adequate for peak flows of about three times the daily average rate.

The sewage quality will vary with the type of establishment, type of activities and predominance of male or female population. By and large, the sewage from summer recreational establishments will tend to be more concentrated and to contain a higher proportion of grease during hours of extensive kitchen operations; and generally a greater proportion of volatile matter will be contained in relation to the hotel solids. Laundry operations in the larger camps and hotels may produce problems of interference with secondary treatment units. These problems can be solved in some instances by the scheduling of discharges and in severe cases by the separation and separate treatment of the laundry wastes.

#### Requirement and Methods of Treatment

The degree of sewage treatment required will vary with the characteristics of the receiving stream, the size of the installation and the requirements of surrounding environment. Under present conditions most states have laws and regulations regarding the degree of treatment required. Where such regulations do not exist, it is the duty of the engineer to provide for sewage disposal to accomplish the objectives outlined above in a manner commensurate with maximum economy.

For the treatment of sewage at the medium or smaller installation the engineer has a choice of two basic methods of treatment: (1) The septic tank followed by a subsurface leaching trench or a subsurface tile field, intermittent sand filter or contact bed; and (2) an Imhoff tank followed by a trickling filter, intermittent sand filter or contact bed, together with sludge drying beds.

For the larger camps and hotels

there are available various excellent "package" plants utilizing the activated sludge process or contact aeration process. These will provide any desired degree of treatment.

In most cases, hand raked bar screens should be provided and in all cases where kitchen wastes are present, grease traps are essential. Chlorination of effluents discharged to water courses is required in most cases.

#### Design of the Plant

Design of the sewage treatment plant should provide for maximum utility and simplicity at least cost; and should recognize the important factors of seasonal use, operation by untrained operators, pleasant appearance and inoffensive operation. Mechanical equipment which might require extensive maintenance after the winter shutdown period should be avoided. Materials used should be of facile availability. Simplicity of construction without the necessity for heavy construction equipment should be given a maximum of consideration. Access to construction sites may be limited, in mountainous areas, by steep and relatively unimproved roads. Where possible, design should permit construction by relatively unskilled hand labor. For sites on islands, the only inexpensive means of transporting equipment and materials may be by sled in the wintertime over the ice.

Full allowance should be made in the design for necessary future enlargement of the plant. All too often the lack of provisions for the future results in added expense later and incongruous and uneconomical layouts. A simple means of measuring flows should be provided.

Maintenance and plant enlargement are immeasurably aided when record drawings are available to show the exact location and nature of underground structures and conduits.

Designing engineers should provide operating instructions for the use of the operator. These instructions should advise as to the function of each part of the plant, the proper manner of its operation and the tools and materials required for operation, maintenance and testing.

#### Typical Design of a Plant

Sandy subsoil and favorable ground water levels generally favor the use of septic tanks or Imhoff tanks followed by subsurface tile field or leaching trench disposal. This method of sewage disposal is

in most cases inexpensive in construction and operation and finds good application when soil conditions are suitable.

Disposal to water courses may be necessary when subsurface disposal is impossible due to unfavorable subsurface conditions or lack of space for the extensive subsurface drainage normally required for the larger installations. Secondary treatment will be required in most such instances. Trickling filters, contact beds, intermittent sand filters, the activated sludge process, and contact aeration—any of these may be chosen for the secondary process. The final selection will be made to secure a balance between economy and requirements for the degree of treatment.

Sewage treatment facilities for a summer camp where subsurface disposal would not be possible are shown in the accompanying illustration. This plant comprises an Imhoff tank followed by contact beds. Sludge is dried on covered drying beds at a downhill location permitting gravity discharge from Imhoff tank. Design is for a boys' camp of 200 persons, with a sewage flow of 50 gallons per capita daily. This plant embodies the characteristics of low cost and simplicity of construction, operation and maintenance and presents a pleasing appearance. The Imhoff tank and siphon chambers are covered with planking and the contact beds are covered with white pebble gravel, which allows aeration and does not expose sewage to view. The plant is thus practically devoid of any odor or flies.

Operation of the contact beds is made automatic by the provision of air-lock feed siphons for control of the inflow and timed siphons at the effluent to control emptying. Beds are four feet deep and are designed for one filling per bed per day when new, and two fillings per day when the voids in the contact material become partly filled. In installations used seasonally such a plant has a long life. The dosing rate is 125,000 gallons per acre per foot depth daily. Contact material is of ½-inch to 1-inch size and distribution of sewage on the beds is accomplished by open joint tile laid in the contact medium.

A plant of this type can be expected to remove 60 to 65 percent of the BOD and 80 to 90 percent of the suspended solids; 60 to 80 percent of the bacteria will be destroyed. Chlorination of effluent can easily be provided where necessary.



# The Blessings and Problems of an ANNEXATION PROGRAM

DEAN SMITH

**W**HAT does a city do when it annexes, all at once, a populated area approximately equal to its own pre-annexation size? Sit back to admire the extent of its own city limits and watch the additional utility revenue roll in?

City officials of Mesa, Arizona, 16 miles east of Phoenix, know better. They know better because Mesa annexed such an area, 2,345 acres, in November, 1948, and the problems brought on by the annexation program are still far from solution.

But even John Hoover, city engineer and utilities supervisor, who fell heir to the lion's share of Mesa's expansion problems, realizes that the city made a wise move. For one thing, the city's population was boosted from 10,000 to about 16,500, an increase which established Mesa as Arizona's undisputed third largest city. Only Phoenix and Tucson now have larger populations. That means a lot, not only in civic pride, but in Mesa's ability to attract new industry, dealerships, conventions of state organizations and the like.

## *The Advantages—and the Disadvantages*

It also gave some 6,500 people who formerly lived outside the city limits a voice in municipal government and gave them such benefits as city fire protection, police protection, lower insurance rates, city utilities and many others. And it is giving the city a much larger share of the state sales and gasoline tax revenues. But perhaps most important to Mesa, it gave the city control over construction in the areas all around it and put a stop to haphazard building that was marring the appearance of its outer approaches.

But there were plenty of disadvantages to annexation, too.

One of the most immediate problems was the sudden loss of some \$35,000 in utilities revenue. Most of the residents of the annexed area were already being served with city water, and a majority were buying gas and electricity from the city as well—all at rates substantially higher than those enjoyed by people liv-



● **NEW SEWAGE** treatment plant, recently completed, is but one of the problems incident to the annexation of adjacent areas.

ing within the city limits. J. Edwin Miller, City Clerk, estimates that annexation resulted in a decrease of 25% in utilities revenue from the area brought into the city.

Then there was expense involved in providing fire and police protection for the new area. New fire hose and chemical equipment—necessitated by the absence of fire hydrants in the district—had to be bought at a cost of about \$2,000. Another police patrol car had to be purchased at a cost of \$2,000 and additions were necessary to the personnel of both the fire and police departments.

## *Improving Water and Sewerage Service*

In a continuing effort to provide fire protection, the city is gradually extending water mains of sufficient

size to the annexed districts and has made a proposition to property owners regarding the installation of fire hydrants. The city is replacing the present 4-inch hydrants in the business district with 6-inch ones—a move which it was planning anyway—and is offering to install the 4-inch hydrants in outlying improvement districts at a saving to property owners of about \$150 under the cost of installing new ones.

To bring the new districts up to underwriters' standards, which call for hydrants at 600-foot intervals on adequate mains, 93 new fire hydrants will have to be installed as well as 26,800 feet of 6-inch water pipe. The hydrants, at \$300 each, will cost \$27,900 and the pipe, at \$2.50 per foot installed, will cost \$47,000, bringing the total to \$74,900.



for new hydrants and pipe. Until the 4-inch hydrants in the business district are used, the city will continue to make the proposition mentioned above. After that time, however, property owners in the new areas will have hydrants installed either in separate improvement districts or as part of sewage improvement districts.

The method being employed to extend sewer lines to residents of the new area deserves special study because it sets a pattern for the extension of other facilities. When Mesa annexed the new territory the city had no sewer lines in the area. Studies made by City Engineer Hoover showed that the land slope was such that the city could serve all the new area and a little more without resorting to lift stations.

### Sewage Treatment

The plant, built at a cost of about \$155,000 by the Cockrell Construction Co. of Phoenix, is located on a bank of the usually dry Salt River bed three miles northwest of Mesa. The city had been relying on two old septic tanks, built in 1914, for all its sewage disposal and was going to have to build a disposal plant in the near future, anyhow. The expansion program simply hastened the project along. A new 24" vitrified clay outfall line has been installed at a cost of about \$225,000 to replace the old 14" line.

Mesa's new sewage treatment plant provides primary treatment in two sets of four sedimentation tanks, and has 2-stage digestion. A mechanically cleaned bar screen was furnished by Chain Belt; the grit

parts of the new area, but a considerable footage of connecting pipe will have to be laid within the next five years to accommodate the new homes which are planned or already under construction.

Underlying all of Mesa's plans for water service expansion is the constant worry about the source of supply. Each year the underground water table goes down about five feet. At present the city is pumping at the 130-foot level; thirty years ago the one city well was pumping water from only 25 feet depth.

### Problems With Streets, Too

The Mesa Street Department's principal problem arising out of the expansion is one of maintenance. There are approximately 30 miles of streets in the new area, about 15



Consequently a program of sewage improvement districts was mapped out. Requests for extension of sewer lines were coming in from property owners all over the new district, but it was recognized that the only practical way to extend service would be to install lines first to the areas just outside the old city limits and then to work gradually toward the outer limits of the annexed area. In that way, each succeeding improvement district could hook onto the sewer line of the district just ahead of it and the installation costs would be kept at a minimum. Ten such improvement districts have already been completed and Mr. Hoover estimates that 2,000 homes and businesses will be tied into the city sewerage system within the next three years.

The City of Mesa, which has had no property tax for the past four years, operates its \$950,000 annual budget primarily with utilities revenue—including a charge of 50¢ per customer for sewage disposal. Since new sewer installations are being paid for by the property owners served and since operating costs are paid for by sewer customers all over the city, the only expense Mesa will incur through sewer expansion is in the new outfall line and sewage disposal plant which was expected to be ready for use this fall.

collector and sludge removal mechanism was furnished by Jeffrey; Chicago Pump Co., Cook and Aurora furnished pumping equipment. The digesters have a diameter of 38 ft., the secondary digester has a floating type cover. Gas is not now being utilized.

Since about 95% of the people living in the annexed area were customers of the Mesa Water Department before annexation, it would not appear that any large additional expenditure would have been necessary. However, the city's three wells were already being taxed to capacity, and it was believed that users of city water in the new areas would increase their consumption as soon as they started getting water at the new low rate. That assumption proved to be true. To take care of the additional consumption the city was forced to sink a new well at a cost of \$27,000. Mesa's four wells now pump 5,200 gallons of water per minute to satisfy a demand which swings from 2,000,000 gallons per day in the winter to more than 5,000,000 gallons in the summer. The demand is expected to increase steadily in the next five years as the subdivisions just added to the city continue with their current building programs. The city already had water mains varying from 4 to 12 inches in diameter extending to most

miles of which must be regularly graded and sprinkled. The additional cost for this maintenance will be about \$10,000 a year. As soon as the sewer, gas and water mains have been laid in a given district, however, the city is encouraging property owners to form a paving district. As additional streets are paved, the problem of maintaining streets in the annexed area will become easier and less expensive. Since the annexation took place, four paving districts including four miles of paving have been formed. As was pointed out in the section on sewer expansion, the formation of new improvement districts is a continuing process, with a new district being started through legal channels as soon as paving is under way in another district.

Another capital expenditure partially occasioned by Mesa's annexation program is a \$50,000 outlay for a new electric transformer sub-station. At present, one transformer sub-station does the entire job. When the new sub-station is put into operation in the south part of the city in the spring of 1950, power will be fed simultaneously to both transformers from the high voltage line to the Salt River Valley Water Users Association transformer, which supplies the city's electricity. Mesa's

(Continued on page 46)

# Study this

## BEFORE YOU PLAN NEXT SUMMER'S FLY CONTROL PROGRAM

*The data herein were developed from an article by H. L. Scudder in  
The American Journal of Tropical Medicine*

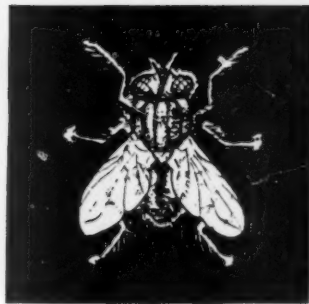
**B**y the use of DDT to supplement sanitation, flies may now be brought under control in homes, restaurants, food markets, and all food industries. Effective fly control, whether insecticidal or cultural, must be based on fly habits.

The objective in DDT spraying for fly control is to leave a thin coating of DDT crystals on those surfaces which flies frequent. This film kills the flies through contact alone, so that if the favorite resting-places of flies are treated, an effective control may be obtained. Because flies rest at night and are active only in the daytime, spraying their nighttime resting-places insures the greatest contact time and heightens the control efficiency of the DDT deposit.

The accepted dosage level for DDT spraying is 7 ounces of DDT deposited per 1,000 square feet of sprayed surface. This rate, also termed 200 milligrams per square

foot, is high enough to allow for many of the inaccuracies of spraying technic. On interior surfaces this dosage usually remains actively toxic to flies for 3 or more months. Outdoors, subjected to attack by the elements, it does not last nearly so long.

In most instances where sanitary conditions are generally acceptable, the use of DDT as a residual deposit on interior surfaces alone is adequate for good fly control for about 3 months, but occasionally the breeding area or fly source is too great and overwhelms the effectiveness of this residual spray. This happens most frequently in industrial plants which have animal or vegetable wastes that are not given prompt disposal. Such conditions commonly occur in feed mills, slaughter houses or abattoirs, fat-rendering plants, hide and fur establishments, seafood plants, and canneries.



● **CONTROL of flies is essential in health protection.**

### How the Spray Is Prepared

DDT-kerosene solution or DDT-Triton-xylene emulsion are the usual spray materials used on interior surfaces. As the amount of liquid absorbed by such surfaces varies greatly, it has been considered best to vary the percentage of the final spray dilution according to the type of surface and still maintain the same spraying technic, thus guaranteeing adequate dosage of DDT in spite of this variation in absorbability. In general, the proper criterion for spraying is to wet the surface thoroughly, but without run-off due to droplet coalescence. With this practice the proper dosage is applied if a 2½% spray is used on rough unpainted wood surfaces such as those found in dairies and other farm buildings; a 5% spray on well-painted or plaster surfaces such as those in markets and industrial plants; and a 7½% spray in restaurants and homes having smoothly finished surfaces. On surfaces with which special care of the finish is unnecessary, some degree of run-off may insure adequacy of treatment, but any run-off leaves visible streaks on varnish and other decorative finishes.

The most efficient equipment for DDT-residual spray application is a low-pressure sprayer, either the hand-compression garden sprayer, a hand sprayer with an air-pressure tank and filler valve, or a machine-operated pump sprayer. With this equipment a fan-pattern spray nozzle should be used at a pressure of from 35 to 60 lb. per square inch. For fine surfaces, a flat atomizing spray nozzle having a 50° fan and delivering 0.15 gallon per minute at 40 lb. pressure can best be used for the 7½% spraying on fine surfaces. For the 5% spraying on painted and plaster surfaces, the 50° fan nozzle



*Courtesy Todd Shipyards Corp.*

● **FOG BARRAGE is an effective method of controlling insect pests, such as flies and mosquitoes, in many areas.**



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Six speeds forward, to 6.03 m.p.h.; two reverse, to 4.15. Weight: 62" tread, 21,000 lbs.; 74" tread, 21,600 lbs. Available with large idler.

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**1 1,000-HOUR LUBRICATION** of truck wheels, support rollers and idlers. You operate six months on a 40-hour week basis with just *one lubrication* . . . instead of daily, or even weekly, attention. Think what this means in labor and lubricant savings . . . and in working time gained! Think of the safety factor, too—no costly damage by greasing neglect.

**2 GENERAL MOTORS 2-CYCLE DIESEL ENGINE** Rugged, simple, economical, "hanging-on" power. Smooth—every down stroke a power stroke . . . less wear and tear on tractor and operator. Far less power loss than other engines at high altitudes.

**3 INTERCHANGEABLE ENGINE PARTS** Nearly all of the GM engine wearing parts are interchangeable with each of the GM engines on the various models of A-C tractors and motor graders—no matter the size. Lowers parts investment, simplifies maintenance for Allis-Chalmers fleet owners.

**4 INSTANT STARTING** GM 2-cycle diesel engines start as easily as your automobile . . . and they *start and operate on diesel fuel*. No need to let 'em idle during work-stop periods—no unnecessary engine wear or fuel waste.

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## *Model* **HD-7**

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Four speeds forward, to 5.00 m.p.h.;  
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13,830 lbs.; 63" tread, 14,000 lbs.  
Available with large idler.

**5 FAST MANEUVERING** 2-cycle diesel tractors are well known for their fast-working ability — not only for quickly traveling from cut to fill, but for turning around instantly in their tracks . . . and for easy maneuvering in and around tight places — especially important on bulldozing. Time saved is money made!

**6 PROPER BALANCE** Weight, speed and power are positively balanced in A-C tractors, assuring top performance on every job — pulling, pushing, lifting.

**7 OPERATOR COMFORT** All these advantages mean operator satisfaction, too — resulting in more work done more easily. Besides — he has a big, wide, comfortable seat, cushioned back, arm rests, roomy platform, convenient controls, good vision.

**8 MATCHED ALLIED EQUIPMENT** Each Allied manufacturer, skilled in his own field, works in complete cooperation with Allis-Chalmers in designing and building auxiliary equipment.

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TRACTOR DIVISION • MILWAUKEE 1, U. S. A.

*Originator of the Torque Converter Tractor*



with a 0.2 gallon per minute output is satisfactory, although for dairy spraying the 50" nozzle with the higher delivery rate of 0.4 gallon is more efficient.

#### Treatment for Outdoor Areas

For outside treatment of fly resting-places, the wettable DDT compounds are probably better than solutions, as they are not as likely to be harmful to plants, and furthermore they appear to adhere more readily to exterior surfaces and to trees, grass, and bushes. In some instances, emulsions have been heavily applied to plants with no damage, but oil solutions are certain to burn foliage badly. It may be best to apply a 5% DDT spray on exterior surfaces, and use a fan spray nozzle having 0.4 gallon per minute output. A higher dosage is consequently applied to cover the unknown values of weathering and adhesion of the spray residue.

Before initiating fly control, one must consider the kind of fly which is responsible for the particular problem, in order to proceed most efficiently with a program of sanitation or DDT treatment. Blowflies (calliphorids), generally considered as the green and blue bottleflies, show many characteristics that separate them from houseflies with regard to their breeding habits, and consequently their control by DDT and sanitation methods. It has been generally observed that if an establishment has no attractants (or breeding places) for blowflies, it has no blowfly population. Blowflies seem to range over a wide area, and in this respect an analogy can be drawn between them and vultures, for a premise may be immaculately kept and have no blowflies, yet if attractant food substances are exposed, a sizeable blowfly population can build up within an hour, the flies having stopped there in their ranging about for food and suitable breeding media. Blowflies prefer not to enter buildings, in contrast to houseflies. In most areas blowflies are more efficiently controlled on a vicinity-wide basis than on a single premise. House flies are very domiciliary, for they tend to stay within a restricted locale and to go inside buildings, especially to rest there overnight in cool weather. They leave their home areas only by accident or by being forced out through the competition of their own numbers. For this reason housefly control may be effective on as small a scale as a single farm, residence, or business. It is then apparent that although housefly control

may be successful on a given premise if flies are not overflowing into it from other premises, blowfly control must always be done on a vicinity basis. However, in abattoirs, seafood plants, canneries, and food processing plants, the blowfly problem may be primarily one of the plant itself.

#### Factors in Efficiency

To insure the efficiency of a control program for flies, or of even a single DDT application, it is of the utmost importance to conduct fly resting-place studies at night to determine where the DDT should be applied. When one considers that because flies are inactive at night, and so rest for several hours in the same spot, and that a DDT application either of a very low dosage or of long-standing (subjected to erosion and degradation by the elements) would be lethal because of such a prolonged contact time, the importance of treating as much as possible of the nocturnal resting-areas becomes apparent. Treatment with reference to just those daytime resting-places on which the flies spend but a very brief period undoubtedly gives control, especially if the treatment is recent or the dosage high; but such a method may neglect a majority of the nocturnal resting-areas and so be unable to compete in rate of kill with the rate at which the flies are emerging from their breeding places.

entries. In cooler weather the houseflies tend to rest inside buildings on ceilings and other overhead structures, although the blowflies continue to choose outside resting-places. Flies show even more gregariousness in their choice of nocturnal resting places than in their daytime activities, a point of distinct value in DDT-residual control work, because this characteristic makes it possible for the control measures to be focused on a greatly reduced area, thereby increasing efficiency and economy.

#### Fly Night-Resting Places

The nocturnal outside resting-places of flies seem to possess several characters in common. They are generally places which are: (1) within 20 feet of the most favored daytime feeding and breeding areas; (2) exposed or prominent in position as vantage points, such as twigs on the ends of low branches, fences, clothes lines, or electric wires, edges or margins of building structures, outer leaves of weeds and low bushes, and isolated weeds taller than the surrounding herbage; (3) protected from direct wind, but still open in situation even if the weather is not calm; (4) above the actual ground level, but rarely more than 15 feet in elevation. Observations made on houseflies resting inside buildings at night have always shown their preferences for edges and prominences which doubtless is



Courtesy Lawrence Aero-Mist Sprayer Co.

- **AERO-MIST sprayer, mounted on a jeep, is highly mobile and can be used to cover hard-to-reach outlying areas.**

Studies of resting flies in various areas at night have revealed an interesting variety of preferences. At night, during warm summer weather, houseflies as well as blowflies rest outdoors, sharing similar resting-places near their major daytime centers of activity about garbage, manure, privies, stables, and kitchen

the underlying principle of their resting behavior outside. Because of these nocturnal resting-habits of houseflies, the emphasis in all interior DDT-residual spraying must be placed on adequate treatment of overhead structures, such as light wires, cords, edges of beams and

(Continued on page 56)



*This is a portion of an address by Prof. Boyce which he presented at the 22nd Water and Sewage Short Course of the Oklahoma Agricultural and Mechanical College, Stillwater, Okla. After outlining the basic concepts on which our regulatory procedures are based, Prof. Boyce continued essentially as follows:*

## WATER AND SEWAGE PERSONNEL RELATIONSHIPS TO HEALTH DEPARTMENTS

EARNEST BOYCE

Chairman,

Department of Civil Engineering,

University of Michigan

**B**ECAUSE the problems of public water supply and sewerage were early recognized as having great public health significance, it was logical that in many states the earliest health laws and regulations related to these. The safety of public water supply and the sanitary disposal of sewage wastes required the combination of properly designed works and qualified and responsible operation. It was, therefore, proper that the laws delegating authority to health departments to supervise the public health aspects of water supply and sewage waste disposal should have extended that authority to include the review of basic engineering reports, plans and specifications, the inspection of the completed utility, and, subsequently, periodic inspection, instruction, and laboratory analysis, to verify the fact that the utility does continuously maintain the standard of quality necessary for the public health protection of the community.

When the water and sewerage utilities are publicly owned we have what might appear to be a duplication of governmental function, with one agency of government, the health department, exercising a policing responsibility with regard to another—the utility service.

### **Function vs. Utility**

However, this duplication is more apparent than real when we examine their governmental bases. The Health Department exercises the authority of governmental control within its sphere of responsibility as

defined by law and interpreted by the courts. The water or sewerage utility exists as a service function that might be performed by either a public or private agency. Regardless of public ownership it retains much of its corporate or proprietary nature, which may be distinguished from the governmental function in many ways.

Authorities on municipal government recognize a distinct line of demarcation between the non-governmental services that are rendered by a city, even though these may be necessary for the very existence of the city, and the basic governmental function that carries with it the authority to supervise and regulate not only the acts of its citizens but also the functioning of the utilities that provide them with service.

### **Water, Sewerage, the Innkeeper and the Blacksmith**

Our utilities are established on a fundamental concept of law that recognizes that certain services can best be provided on a non-competitive basis. There must be a contractual relationship between the governmental agency and the utility management whereby the utility in return for certain exclusive privileges surrenders some of the freedoms of private business and assumes in return quasi-public responsibilities. The utility as a public servant has an obligation to provide an acceptable service to all alike without discrimination. The regulatory governmental bodies represent the pub-

lic and determine the acceptability of the service rendered. This concept of public or governmental responsibility for the functioning of services upon which the public must depend goes back to old English common law that required that the innkeeper serve the traveler dependent on the inn for shelter, and the blacksmith to shoe the traveler's horse.

When the citizens of a community decide that an existing governmental agency shall undertake the administration of a water or sewerage utility it is important to the governmental function and especially to the utility service that the separate purposes of these two functions undertaken by the same elected representatives be recognized.

When a municipal governing body is engaged in the administration of a publicly owned utility it is functioning as a board of directors of a publicly owned business and as such should provide service but not regulation. In its proprietary function as the manager-operator of a publicly owned utility service a city maintains a contractual and not a governmental relationship with the consumers of the service, and in this capacity assumes the liabilities that may arise from injury resulting from the method or quality of service rendered.

In contrast to the contractual responsibilities of a water or sewerage utility, the health department is organized as a function of government.

(Continued on page 68)

## Mesa's Annexation Program

(Continued from page 40)

industrial growth has been so rapid in recent years that it is no longer practical to run heavy lines from the single transformer across the city to the industrial users. The new substation will eliminate the necessity for the heavy lines and will stabilize the load on the entire electrical system. It will also provide a safety factor in case one of the sub-stations becomes inoperative.

### Gas and Electrical Problems

Another problem faced by the Electric Department is that of supplying power to an estimated 600 customers in the new area who are now served directly by the Water Users Association. These now lie within the city's power franchise and will be served by the city as soon as arrangements can be made to purchase the Water Users' poles, lines and associated equipment. Mesa will have still another problem in serving these customers, since many of them have 25-cycle electricity. A gradual replacement of 25-cycle equipment with 60-cycle equipment is now in progress. New feeder lines from the city's transformers must also be put in. Line replacement costs are expected to reach \$40,000.

Mesa's skyrocketing population had put a heavy strain on the city's Gas Department even before the annexation program was started. At that time a majority of the residents in the annexed area were using bottled gas or none at all. But with the expansion of the city limits, the cry for natural gas was immediate and loud. In order to have sufficient pressure left at the outer extremities, the city is replacing old gas mains with larger ones and installing service lines as rapidly as possible. It is now apparent that a new and bigger line must be put in before the winter months to connect the city mains with the cross-country line of the El Paso Natural Gas Co. Mr. Hoover estimates that this line will cost the city another \$60,000 and that other line replacements will cost another \$60,000.

Garbage collection in the new districts will not be a financial problem to Mesa since collection is contracted to a Phoenix garbage disposal firm and the cost distributed equally among the customers served. At present a levy of 75¢ per month per customer is made.

In summary, then, capital investment expenses to the city of Mesa

which have been brought on in whole or in part by the expansion program are as follows:

Fire Department	\$2,000
Police Department	2,000
Water Department	
(New mains and new well)	65,000
Sewer Department (Disposal plant and lines)	380,000
Electric Department	
(Sub-station and lines)	90,000
Gas Department	120,000

Total \$659,000

There will be additional annual operating expenses as follows:

Street Department	\$10,000
Fire Department	13,000
Police Department	6,000

\$29,000

Just how much of this expense is chargeable to the expansion program and how much would have been necessary without it is virtually impossible to determine. Nevertheless, it is expense which must be met by the city and, until a sufficient number of utilities customers can be added, annexation will put a heavy drain on the city treasury, which is already depleted by the \$35,000 cut in utilities revenue because of the annexation program.

By boosting the water rate for the 1949-50 fiscal year the city plans to make up about \$30,000 of the deficit. However, the City of Mesa may find it necessary to institute a city property tax during the fiscal year 1950-51 and keep it in effect for several years, until the expenses of annexation can be neutralized by increases in utilities income.

## Chlorine Dioxide As A Bactericidal Agent

FRED V. H. PIPER

Director of Water Dept.  
Niagara Falls, N. Y.

THE water supply for Niagara Falls is secured from the East Branch of the Niagara River, which receives sewage and industrial wastes from communities on the river and along the east shore of Lake Erie. Therefore the effective disinfection of the supply with chlorine has been complicated because of the production of chlorinous tastes incidental to industrial wastes and because of secondary tastes which have developed in the distribution system. These secondary tastes are largely associated with the mains in the southern portions of the city which have been in use for over 50 years and which contain considerable deposits.

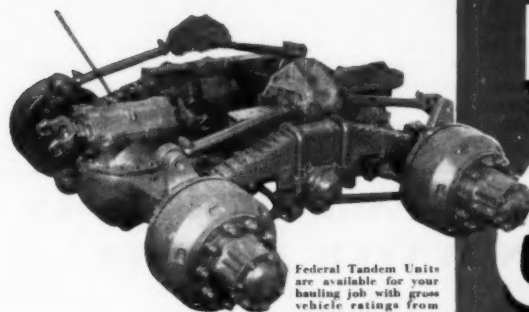
The subject is still further complicated by sudden changes in the hydraulics of the distribution system, due to the fluctuating demand for water by large industries, which cause stirring up of the deposits, thus aggravating the taste and odor control problem.

### Chlorine Dioxide Treatment Adopted in 1944

In order to control tastes and odors more effectively the city adopted chlorine dioxide treatment in 1944, this chemical being added to the filtered water entering the distribution system of the city. In spite of the improvements noted with this treatment process, which was used in connection with prechlori-



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nation by chlorine alone, tastes and odors still occurred at intervals. Accordingly several hundred samples were collected from the distribution system in order to correlate any observed tastes and odors with the concentration of free residual chlorine, combined residual chlorine, residual chlorine dioxide and any sodium chlorite which might have remained in the water treated with chlorine and sodium chlorite to produce chlorine dioxide. These special analyses were made with the assistance of a representative of the Mathieson Chemical Corporation, which developed the chlorine dioxide treatment.

#### **Pre-treatment with Chlorine Dioxide Started in 1949**

The results of this preliminary study were discussed with representatives of the New York State Department of Health and of the Mathieson Chemical Corporation. It was concluded that the data disclosed that in the great majority of cases samples from the distribution system having an odor contained free residual chlorine in concentrations of 0.05 ppm or greater. It was concluded, therefore, that it would be desirable to study sterilization of the supply with chlorine dioxide, using only sufficient chlorine to react with the sodium chlorite used in the formation of the chlorine dioxide. Accordingly on April 21, 1949, post-treatment with chlorine dioxide was temporarily abandoned and in its place pretreatment with chlorine dioxide was instigated. Following filtration the supply was treated again with sufficient chlorine to maintain a free chlorine residual of 0.2 ppm.

In order to disclose the effects of this treatment process a program of more frequent bacteriological examination of samples of water from the distribution system was started. It was found that there was a complete absence of coliform organisms in the treated water. After a trial period of one week the dosages of chemicals were adjusted to maintain a chlorine dioxide residual of 0.5 ppm in the pretreated water prior to filtration.

#### **Post-Treatment Discontinued**

It was found that this treatment gave satisfactory disinfection and satisfactory control of tastes and odors in the filtered water prior to post-treatment with chlorine. On the other hand, the final effluent following post-treatment to provide 0.20 ppm residual chlorine contained a slight chlorinous taste and odor.

In view of the satisfactory disinfection being secured with prechlorination with chlorine dioxide, post-treatment of the filter effluent with chlorine was reduced to secure a residual of 0.15 ppm. More recently post-treatment was discontinued, inasmuch as pretreatment with chlorine dioxide alone was found to be reliable and adequate and that it

provided a free chlorine residual of 0.15 ppm in the filtered water. Further studies must be made, however, before final conclusions are reached as to the most effective manner of using chlorine dioxide in our water treatment process.

This article is from the Water Works News, publication of the New York State Dept. of Health.

## **PEAK PUMPAGE RESULTS IN LESS WATER REVENUE**

JOHN HUBEL

THE "goodness" of Waukesha's (Wisc.) water is almost fabulous. Brewers brag about using it in their beer. Back in 1893, during the Columbian Exposition, some Chicago folks got the bright idea of piping Waukesha spring water to the World Fair Grounds. A pipe line was actually started, but either money or enthusiasm gave out when the digging for the line got a few miles out of Waukesha. However, Waukesha water has been sold in Chicago offices and homes, in 5 and 10-gallon containers, for 50 years, and in many Wisconsin cities as well.

It is natural, therefore, that the citizens of Waukesha should be proud of their water supply; but despite peak pumpage during 1948, Arthur P. Kuranz, Water Works Superintendent, reported a net decrease in revenue of \$3,630. A billion gallons of water—the largest amount on record—was pumped in this city of 24,200, during 1948, but this peak pumpage did not show a profit, as a rate cut ordered by the Wisconsin public service commission made the average water bill 52¢ per quarter lower per customer than was the case in 1947.

A "loss" of 170 million gallons of water was reported by the city in 1948. This, Mr. Kuranz says, was due mostly to leakages in the system. This leakage was due to lack of adequate maintenance of the piping, valves, and other parts of the system. During the war years, and for a while after, it was practically impossible to obtain materials to maintain the efficiency of this system. According to Mr. Kuranz, the amount of water pumped into the system and paid for was 91% in 1945, 90% in 1946 and 83% in 1947. Last year it was 82.7%. In recent months, the repair work has been accelerated as material and repair parts are again obtainable in fair quantity.

In discussing this situation, Mr.

Kuranz says: "While the actual accounted-for water was the lowest last year since 1938, we are encouraged by the fact that the last six months of 1948 showed considerable improvement over the like period of 1947, and the elimination of leaks gradually improved this phase of the work. The surreptitious use of water is not widespread in Waukesha, and in fact, is not as great, in all probability, as it is in many other industrial cities."

The organization for water supply for the year was perhaps the best that it has been for some time. No particular problems arose. The greater part of the water pumped into the system came from the Baxter well, the total from this source being about 330,000,000 gallons, or 32% of the total for all wells; 27% came from the Newhall well; 22% from the Moreland well; and 18% from the North Street well. The maximum use of water for any one day was on August 25th—4,517,000 gallons. The minimum amount of water used on any one day was on April 18, which was a Sunday, when the total was 1,608,000 gallons.

All of the pumps are motor driven except the pump at North Street Station, which is driven by a Diesel engine. Cost figures show that the cost of operation of the Diesel driven pump, including interest and depreciation, but excluding a periodic overhaul was \$7,000 for the year. The comparable cost of electric power, if the pump were motor driven, would have been \$5,653. However, it is considered good policy, where several pumping plants are operated, that at least one have Diesel power, as a standby in case of utility power failure which would put electrically driven pumps out of commission. The Diesel driven plant at North Street station is capable of keeping up the supply of water in the reservoir if electric power is cut off.



## WHAT IS STREAM POLLUTION?

**T**HE industrialist, the general public, the conservationist, the sportsman and the regulatory agency all have somewhat contradictory ideas as to what constitutes pollution. The industrialist feels that the reasonable use of waters for the transportation of wastes should not constitute pollution; the general public is interested in having waters available for drinking, bathing and other recreational uses; the conservationist would like to see all the rivers restored to a state of pristine purity, and so would we all, of course; the sportsman is interested primarily in catching fish, and the regulatory agency representative is in duty bound to support the definition of pollution as specified in the particular legislation under which his office functions.

This conflict of interest makes it necessary to judge each particular case by the various factors which are involved and, in the end, calls for a very careful analysis of the private and public equities involved in the specific case and a balancing, one against the other, of these equities.

The National Council for Stream Improvement supports the "reasonable use" concept which is held by many stream sanitation authorities. This is—that the use of a stream for the transportation of wastes is necessary and proper, provided that such use does not constitute a menace to public health, does not create a public nuisance and does not prevent the use of the waters for the purposes to which they are normally and customarily put.

Natural pollution resulting from silt and decaying vegetation is of far more importance than is generally realized, particularly in the south where in many cases decaying vegetation makes a greater demand on the oxygen in the stream than does either municipal or industrial waste.

Municipal sewage is by far the most important pollution problem, since it constitutes a grave menace to public health and contributes greatly to the unsightly and slovenly appearance of the stream.

Industrial waste, or more specifically pulp and paper industry waste, on the other hand, does not constitute a menace to public health although it may create a public nuisance with low stream flow.

These data are from an address

before the American Pulp and Paper Mill Superintendents Association by Russell L. Winget, Exec Sec'y., Nat'l Council for Stream Improvement.

### Improving the Daytona Beach Sewage Treatment Process

The sewage treatment plant at Daytona Beach, Fla., was described in the April, 1949, issue of Public Works. This plant, which uses water plant waste lime for coagulation, is unusually compact. Plants embodying the same general methods are now being considered for other Florida cities, using local pulverized lime rock or other available materials for coagulation.

In some cases, a higher degree of treatment is desirable than was necessary at Daytona Beach. In the Daytona Beach plant, it was found that the addition of a small amount of diffused air, added with the calcium carbonate, gave improved results. Accordingly, these newer plants are being designed to employ from one-tenth to one-half of a cubic foot of air per gallon of sewage. Joe Williamson, Jr., of Russell & Axon, consulting engineers on the Daytona Beach plant, estimated (in a paper before the Florida Public Health Engineering Conference at Gainesville) that one-half cubic foot of air per gallon and 50 to 100 ppm of calcium carbonate, would result in a removal of 82% of the BOD, with 2 hours detention. Where BOD removal of 60% to 65% is satisfactory, one-tenth of a cu. ft. of air will be provided with a detention period of one hour.

### Air Diffuser Plates Cleaned With Oxy-Acetylene Flame

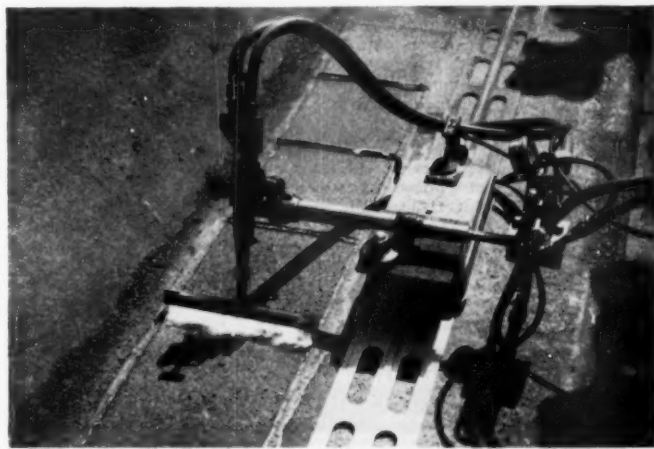
J. C. KERR

Linde Air Products Co.

**S**URFACE clogging of air diffuser plates in activated sludge plants has often been a problem since usual cleaning methods may be time-consuming and costly. Recently, a method of flame cleaning was used. Trial tests showed that this method did an excellent job of spalling off the clogged surface material. It was possible, by this method, to remove uniform thin layers of the surface until normal air passage through the plates was established.

For the flame cleaning operation,

an Oxyweld oxy-acetylene blow-pipe with a 12-inch wide flame cleaning head was used. A crew of 3 men did the cleaning. One man ran the Oxyweld machine; a second man handled the hose from the oxygen and acetylene cylinders; and the third man brushed off and swept up the spalled-off material. The 2-man crew cleaned the plates in one tank in 6 hours. This tank was 346 ft. long, 32 ft. wide, and 16 ft. deep, and contained 280 sintered aluminum oxide plates.



● **HOW THE flame cleans air diffuser plates.** About 1/16 inch of the clogged surface is spalled off at each pass.





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**Public Works  
ENGINEERING  
DATA**

**How to Find Sewers With a Pipe  
or Leak Locator**

**Joseph Griebel,**  
Superintendent of Water Works,  
Liberty, N. Y.

To locate the course of an unknown sewer, get into the nearest manhole. Fasten a piece of log chain, or other heavy chain, to the end of a sewer rod. Using as many sections of sewer rod as may be needed, push these, with the chain at the end, into the sewer to a point near where you wish to locate the line. By moving the chain back and forth a little with the rods, a leak detector will locate the noise made by the chain and its exact location.

In much the same manner, by pushing a steel cable, or other metal, past the point of unknown location, an M-scope or similar electrical locator will give you the exact location and course of the line.

I have used this method for locating house sewer connections. Using a flexible steel rod or even a so-called plumber's friend, a piece of chain can be pushed out to the street sewer and the connection quickly located with the leak locator. By moving the rod back and forth a little, the chain makes enough noise so that it can be located exactly. If enough metal is used, the connection can be located with a pipe finder.

The same methods are useful also in locating the course of culverts under highways. Where these are of metal, the loose chain and the leak detector will usually work best. Where the culverts are of clay or concrete, the chain or other metal piece and the pipe locator are good. These methods can be used for locating many kinds of pipes, the exact location of which is unknown, and a great deal of costly digging can be avoided.

**Charges for Removing Snow From  
Sidewalks**

**John Hubel**

Removal of snow from all sidewalks in the city at the property owners' expense was suggested to the City Council of Milwaukee, Wisc., in 1948, the cost for the work to be included in the annual taxes on the property. That idea, while not entirely abandoned, has now evolved into a proposal that the snow on the sidewalks of business streets be removed by the city and the property owners be charged 10 cents a front foot for this service, the work being done by city crews. Strenuous objection has been raised to this proposal by the Downtown Association of Milwaukee which, through its secretary, said: "Streets are the property of the City and not of the property owners abutting on those streets. The use of the

streets is not restricted to the owners of the abutting property, nor is it for the sole service of those properties. The fair way to allocate the cost is to include it in the city budget, which is contributed to by all residents." Mayor Frank P. Zeidler is reported in favor of snow removal from sidewalks in the business sections, doing the work with city forces and making an appropriate charge for the work.

### Wage Rates on Highway Projects

Average hourly wage rates on Federal Aid Projects for the fourth quarter of 1949 have been announced by the Bureau of Public Roads. Skilled labor averaged \$2.02 per hour. The highest rates were in the Middle Atlantic States—\$2.41; and the lowest in the West South Central—\$1.62. Average rates for intermediate labor were \$1.94, with the highest in the Middle Atlantic States—\$1.78; and the lowest in the East South Central—\$1.11. Unskilled labor ranged from 81¢ to \$1.46 per hour, and averaged \$1.17.

### Color Scheme for Repainting Hydrants

Repainting of 818 public fire hydrants is described in the recent report of the Charleston, S. C., Water Department, of which F. B. McDowell, Jr., is Manager and Chief Engineer. The cost of repainting was \$1,200. The barrel of the hydrant immediately above the sidewalk level was painted black; above this, the barrel was painted yellow to the dome; and the dome was painted aluminum. On each hydrant was stenciled its proper number.

### Costs for Highway Construction, Third Quarter, 1949

The price index for Federal Aid construction for the third quarter of 1949 has been released by the Bureau of Public Roads. Bid prices on common excavation averaged 38¢ per cu. yd., or 108.6% of the 1925-29 base. For other items, bid prices and relation to the 1925-29 base were: Concrete pavement per sq. yd., \$3.56 and 160.4%; structural concrete, per cu. yd., \$47.21 and 205.8%; composite mile of road, 147.7%. Costs have declined since the fourth quarter of 1948, when the composite mile index was 165.3%.

### Maximum and Minimum Water Consumption in Tacoma

The total average daily consumption of water in Tacoma, Wash., during 1948 was 50,430,000 gallons, of which 17,070,000 was delivered to pulp mills supplied by the Water Division. The maximum day's consumption was 70,300,000 gals. on June 30; and the minimum consumption was 30,200,000 on May 30. Average daily consumption, exclusive of the pulp mills, is 221 gals. The estimated population served is 151,000, including about 12,000 outside of the city.

### New Diesel Engine for Auburn, Nebr.

A new 1,440-hp diesel engine has been placed in service by the Auburn, Nebr., Municipal Power Plant. This is a Superior, 14½ x 20, and it replaces an older 300-hp unit. The engine is a dual fuel unit, which can operate on oil, natural gas or combustible by-product with equal efficiency. This is the second Superior unit installed within the past two years.

# 4

## important facts that you should know about swimming pools

If you are charged with responsibility in connection with the swimming pools of your community, you know that proper health standards must be maintained. The time to insure proper hygiene and safety for bathers, to provide a constant supply of clean water and correct drainage, and to secure maximum service from your pools is before you start construction. Make sure that these four facts play a prominent part in your pool plans:

### 1. THE POOL WATER AND CONTENTS SHOULD ALWAYS BE COMPLETELY RECIRCULATED

The Josam Injector Nozzle and Recirculating Supply Fittings guarantee continuous recirculation of over 90% of pool water, thus eliminating the possibility of "dead spots."



Josam Series 0700-B  
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with recirculation feature

### 2. THE POOL SHOULD BE SAFEGUARDED AGAINST UNSANITARY CONDITIONS

Josam Promenade and Scum Gutter Drains accumulate and retain debris, preventing foreign matter from clogging lines and fouling equipment.



Josam Series 0490  
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### 3. THE DRAINAGE SHOULD BE ADEQUATE, YET COMPLETELY SAFE

Josam Main Outlet Drains eliminate dangerous suction by allowing water from pool to drain slowly, but in sufficient volume to completely drain pool in 4 hours or less.



Josam Series 0670-B  
Scum Gutter Drain  
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### 4. THE POOL DESIGN SHOULD COMPLY WITH MODERN STANDARDS OF HYGIENE

You can meet modern standards of both hygiene and recreation by consulting local Architects or Engineers, and mailing the coupon below for Josam Manual SP on the latest facts and information covering water recirculation and drainage.

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# PUBLIC WORKS DIGESTS

WATER WORKS.....52 • HIGHWAYS AND AIRPORTS .....58 • SEWERAGE AND REFUSE ....61

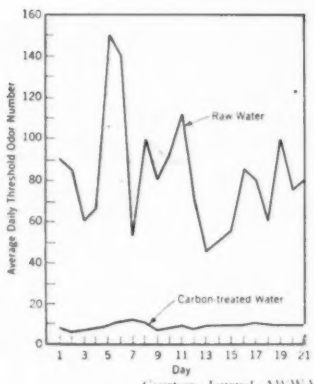
*This section digests and briefs the important articles appearing in the periodicals that reached this office prior to the 15th of the previous month. Appended are Bibliographies of all principal articles in these publications.*

## THE WATER WORKS DIGEST

### Odor Control For An Unusually Bad Water

It is doubtful that there are any other water works in the country that have to treat water as bad as that which Whiting, Ind., obtains from Lake Michigan. The lake here receives the sewage from six municipalities, including Whiting's, four of which (not including Whiting's) are treated; also industrial wastes from large steel mills, oil refineries, soap works, corn products plants and others. In March 1947 an oil film on the lake caught fire and burned for several hours. The authors believe that "it is beyond reason to expect even the best equipped and most modern plant to produce a satisfactory drinking water using raw water of the quality supplied to the Whiting plant." However, in an effort to improve conditions, especially as to odor control, they conducted experiments with the use of fuller's earth, chlorinated coppers (alum was being employed at the plant), chlorine dioxide, free residual chlorine, chloramine, granular activated carbon, powdered activated carbon, and ozone. After five months of experimenting they reached the following tentative conclusions:

Dry fuller's earth applied to the plant influent successfully removed the heavy oil film on the water. Chlorinated coppers reduced the dissolved oil content of the water. Neither chlorine dioxide nor free residual chlorination gave satisfactory results, but chloramine treatment gave promise of success. The granular carbon filter did not materially reduce the threshold odor, probably because it could not be



● **POWDERED activated carbon results.**

cleaned properly. Ozone proved incapable of combating the taste and odor problem. By using powdered activated carbon the threshold odor could be lowered to practically any desired point, if sufficiently large quantities were applied—80 to 140 ppm.

Leo Besozzi and J. C. Vaughn—"Experimental Studies of Odor Control at Whiting, Indiana," *Journal Am. Water Works Ass'n*, November.

### Superchlorination Of London's Water Supply

Since 1940, superchlorination has gradually displaced chloramine treatment for the Metropolitan Water Board's well waters; and of 1772 samples of well water so treated during the past 5 years, *B. Coli* have been detected in only 0.08%. There have never been any com-

plaints of taste. In 1948 superchlorination was adopted at all the Board's filtration works treating river water also. In addition to reduction of bacteria, color is reduced 23% and complaints of chlorinous tastes have ceased. Because of the speed with which it destroys bacteria, the size of the contact tanks is reduced 50%. Due chiefly to the disuse of ammonia gas and ammonium sulfate and a reduction in the total amount of chlorine used (pre-chlorination has been discontinued as unnecessary) there is a saving of £10,000 a year. At most of the works, instruments are in operation that record continuously on a chart the residual chlorine in the water after a given period of contact.

"Superchlorination: Successful Use in Metropolitan Water Board's Works" *The Surveyor*, Nov. 11.

### Diversion Of Reserve Funds

This panel discussion was contributed by representatives of the North Atlantic states, the North Central states, the East South Central, the West South Central, the Mountain and the Pacific states, respectively. A summary of the report from the North Atlantic states that diversion of water department surplus funds is practiced widely, with no harm resulting when sound financial principles are used. As costs vary widely, resulting in variations of surplus, unnecessary surplus can be turned back to the citizens in the form of diversion instead of reducing rates. Regulatory powers should be vested in some state authority to deter unscrupulous use of surplus funds.

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John C. Detweiler, for the West North Central states, first states that diversion may be either direct, or indirect by renunciation of potential revenue from street, sewer, park and fire departments and the public schools. He finds that cities having the most difficulty with diversion of water works funds are those where all the water works revenues are paid into the general fund and the expenses allowed against this fund. Where the water works are operated by a separate board the water works funds appear to be under control.

In the East South Central states, says C. M. McCord, the practice follows no particular pattern but varies from one extreme to the other, but there is a slight tendency toward less diversion. Some communities have a tax rate as high as the law allows and, requiring more funds, turn to the water department as the only medium for obtaining them.

In the West South Central states, diversion of water works funds to other city departments is more the rule than the exception, says Albert R. Davis. If the tax payers of any

community, through their council, desire to pay part of its taxes in the form of excess water rates, then the water officials are obligated, by democratic principles, to adjust such rates accordingly; but it is their duty to inform the electorate what part of the water rates they pay is diverted to other purposes.

In Montana, the Public Service Commission proposes that the water works funds be administered for the benefit of the water users only. In Arizona it is considered the proper procedure to use surplus water works funds to relieve the tax burden. Among the other states of the Rocky Mountain section, the general practice is to keep water works funds intact and in a separate account, but there are a number of exceptions. In a few cases the water revenues do not pay the expenses and an appropriation is made from the general treasury.

The Washington State Supreme Court has held that a city has the right to raise water rates so long as they are not exorbitant; and this apparently includes the right to include in them a "hidden tax". During the past ten years, Seattle has diverted to the general fund \$9,230,000, or 32.67% of the gross revenue of the water department.

"Diversion of Water Department Reserve Funds"; *Journal Am. Water Works Ass'n*, November.

#### Charges For Fire Protection

At the Annual Conference in 1949 of the A.W.W.A. there was a panel discussion on Water Rate Structures, in which 9 members took part. There appears to be "an amazing confusion about the basis for their (water rates) determination and a wide diversity not only in existing rates, but in the schedules being currently proposed by leading water works engineers." The discussion was in general grouped under the heads "Amount of Revenue Needed", "Depreciation and the Rate Structure", "Fire Protection Charges", "Demand and Service Charges", "Steps in Rate Schedules," and "Application of Michigan Section Committee Formula."

Said Louis E. Ayres; "The one element in water works cost that may be evaluated with some degree of precision is fire protection." and he and the others referred to the 1911 paper by Metcalf, Kuichling and Hawley as the classic in water works literature dealing with this subject. A simplification of their method that was suggested was to base the capital costs chargeable to fire protection on the ratio of the

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maximum fire demand to the total combined demand, multiplied by the ratio of the increase in cost to the increase in capacity.

Richard H. Ellis cited data collected in 1945 which showed that, of 462 water works, only 197 collected anything for fire protection, and in many cases this is only a "token" payment of 0.2% to 5% of the total revenue from all sources; and only 4 receive anything near the proportion indicated by the Metcalf-Kuichling-Hawley formula. In only one state, where municipal works are under public utility regulations, did the average receipts for general fire service equal 22%. However, where the water works pays no taxes, the amount which it would have paid if under private ownership may be considered as offsetting that amount of the city's indebtedness for fire protection. The author suggested rendering bills to property owners in which charges are entered both for water consumed and for fire protection service, the latter being based upon the assessed value of the property; which plan would not levy an unduly high fire service charge on an owner because he consumes a large amount of water in his business, while on the other

hand, a business conducted on very valuable property but by which practically no water is consumed would not escape having to make a payment for fire protection proportional to the value of the property protected.

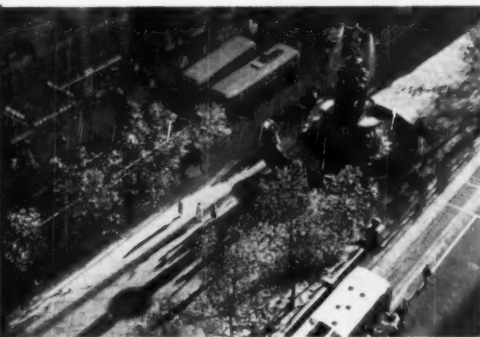
"Rethinking Water Rate Structures," *Journal, Am. Water Works Ass'n*, November.

#### New Type of Prestressed Concrete Pipe

There is being constructed for the East St. Louis and Interurban Water Co. 5,200 ft. of 54" prestressed concrete pipe, made by the "Rocla" method, developed in Australia and used only once before in this country. The process involves roller-compaction of a dry concrete in a rotating mold to make a core; wire-wrapping this core, and covering it with air-applied mortar. A casting mold of  $\frac{1}{4}$ " steel 16½ ft. long hangs loosely from a horizontal steel spindle 16" in diameter that passes through it and is supported at each end, is driven by an electric motor, and so revolves the mold and at the same time compacts the concrete as it builds up into a shell on the inside of the form. A belt conveyor delivers into it a batch consisting of

600 lb. of  $\frac{3}{4}$ " aggregate, 200 lb. of  $\frac{1}{4}$ " aggregate, 200 lb. of coarse sand, 23 lb. of fine sand, 3 bags of cement and only 10 gal. of water (a 0.45 water-cement ratio). Before applying the cement, a cage of welded steel fabric reinforcement is placed in the mold to help resist handling stresses prior to the wire winding. The mold is rotated at 60 rpm. The entire weight of mold and concrete is supported by the spindle, and supplies the pressure to the concrete shell, as it passes over the spindle. The core is steam cured and then is wound with 8-gauge high-tensile steel by machine under a stress of 140,000 psi. The wire is wound spirally with a pitch of 16½" (86" in some cases) and therefore prestresses the pipe longitudinally as well as circumferentially. The winding carriage passes back and forth along the pipe, applying the wire in 30 to 60 spirals, which form a basket weave. It is then covered with  $\frac{3}{4}$ " of cement applied pneumatically, and steam cured. A test pipe withstood a 3-edge bearing load of 17,600 lb. without visible cracks (three times the load called for by the A.S.T.M. specifications for reinforced concrete sewer pipe), and an in-

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ternal hydrostatic pressure of 54 psi.

"New Casting and Prestressing Techniques for Ultra-Strong Concrete Pipe"; *Engineering News-Record*, October 6.

### Algae and Tastes in Water

Odors caused by algae may be associated with the growth of the living organism but may be intensified by decomposition or by destruction by chlorine, copper sulfate, etc. Also, the microbial population of water utilizes dead algae as nutrient material and in so doing may produce products that cause tastes and odors. Probably algae contain many of the carbohydrates and fats found in other green plants, the decomposition of which yield organic acids, alcohols, ketones and esters which may be odoriferous. The decomposition of algae and other water plants by actinomycetes should be investigated. These may not only produce products different from those formed by true bacteria, but they themselves possess a decided earthy odor.

Gerard A. Rohlich and William B. Sarles—"Chemical Composition of Algae and Its Relationship to Taste and Odor"; *Taste and Odor Control Journal*, October.

### Silver Ions As Cysticides

It has long been known that silver ions are toxic for bacteria, but little information is known as to their efficacy for destruction of cysts. Experiments were conducted by the authors on *E. histolytica*, obtaining the silver ions by the electrolytic method, using silver foil electrodes and a current flow of 6-7 m a at 6.2 V for one hour in one series, and using silver nitrate in another. The conclusion reached was that such cysts can be destroyed by silver ions, but it would appear that the concentrations and exposure periods required are considerably in excess of those usually suggested for the treatment of drinking water supplies.

Walter L. Newton and Myrna F. Jones—"Effectiveness of Silver Ions Against Cysts of *Endamoeba histolytica*"; *Journal Am. Water Works Ass'n*, November.

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Deep Well Pump Testing, By Frank C. Miramontes, Pump Test Supervisor, Pacific Gas & Electric Co., November, Pp. 1013-1026.

Effectiveness of Silver Ions Against Cysts of *Endamoeba histolytica*, By Walter L. Newton, Sanitarian, and Myrna F. Jones, Medical Parasitologist, Nat'l Inst. of Health, November, Pp. 1027-1034.

Experimental Studies of Odor Control at Whit- ing, Ind. By Leo Bezzi, Cons. Engr., and J. C. Vaughn, Filtration Engr., Dept. of Pub. Wks., Chicago, November, Pp. 1035-1043.

Remodeled Cornell University Filter Plant, By F. R. Georgia, Supervisor of Water Works, Cornell Univ., November, Pp. 1047-1052.

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Let's Sell Water, By Farley Gannett, Cons. Engr., Nov. 24, Pp. 39-40.

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Subsidence in an Earth Reservoir Embankment, By Andrew Wilson, Deputy County Engr., Nov. 4, Pp. 663-665.

Superchlorination in Metropolitan Water Board's Works, Nov. 11, P. 676.

## Fly Control For Next Summer

(Continued from page 44)

other woodwork, and all irregularities in the ceiling structures.

The total control effect exerted by DDT-residual spray measures is of course limited in any instance to the total amount of fly resting-area that can be treated. If all resting-areas in and about a given premise are wholly treated, it follows that because the total capacity of those sur-

faces is the limit of such control measures, the flies produced in excess of such a capacity go uncontrolled. This uncontrolled amount, the unseen output of an area of heavy fly breeding, simply keeps the resident population replaced as fast as it is killed off, leaving no apparent control value, but in reality suppressing the overflow which had been migrating to other areas. If real control value is to be achieved at the focus of extreme fly breeding, then measures in addition to the DDT-residual treatment must be employed to reduce the volume of breeding. Proper waste disposal or larviciding are therefore necessary to assist the DDT residual in reducing the number of adult flies below the level of premise capacity. Under conditions of fly breeding in excess of the capacity of a premise for adults, it has been observed that all conceivable breeding places become infested.

A light population is far easier to control, and is particularly adapted to check by a well-placed DDT-residual treatment, which can exercise such efficient control that only a few of the potential areas available later become infested. If the fly population is allowed to increase to the point at which it infests all potential breeding places, then the fixed area treated by the DDT-residual may be inadequate for control of more than a small percentage of the flies, and so have no suppressive effect at all on the extent of breeding. Consequently, the initiation of fly control early in the season, or at a time when flies are least numerous, tends to restrict the breeding to fewer places and so make control easy to maintain.

### The Flight Range of Flies

The flight range of flies, especially of houseflies, has often been studied, but the factors underlying fly migration and the degree to which it figures in their control are still not well understood. It is definite that flies under certain circumstances, especially under conditions of high population pressure, can and do migrate over areas up to a few miles in extent.

The migration of both houseflies and blowflies out of areas of high population pressure, such as may exist about poorly sanitized industrial plants and city dumps, is usually the reason for a high fly index over an entire municipality. Consideration of these factors of fly migration makes it apparent that the control of heavy breeding areas is of singular importance.



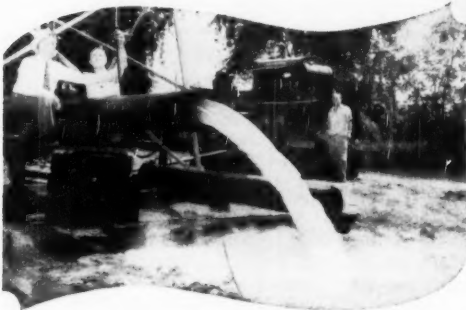
Courtesy Chapin

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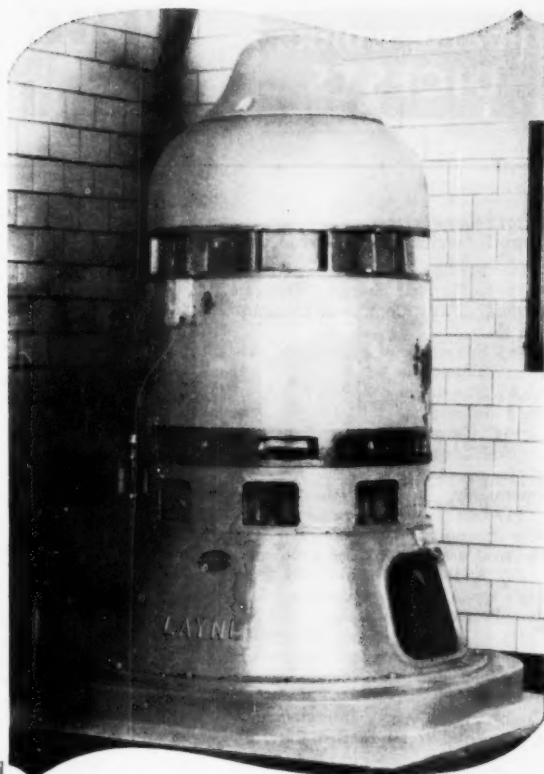
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## PUBLIC WORKS DIGESTS

# THE HIGHWAY and Airport Digest

### Direct-Connection Type Interchanges Preferred

In the light of past experience with traffic interchange, Michigan State Highway Dept. is of the opinion that:

- (a) Simplicity of design is of primary importance.
- (b) The direct connection type of road interchange for major movements is most desirable.
- (c) Intricate designs create traffic confusion, and are difficult to sign adequately.

(d) Interchanges requiring excessive amount of right-of-way, even in rural areas should be avoided.

(e) Acute angle take-offs from high-speed roads interfere with smooth traffic operation.

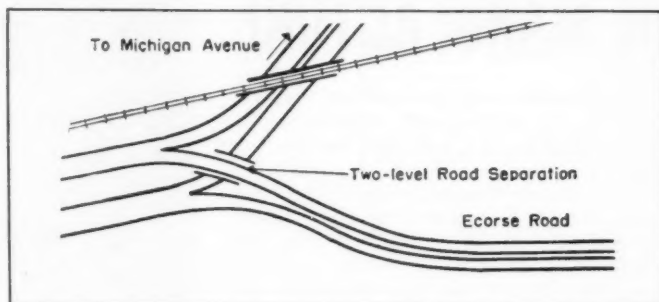
(f) Cramped designs of insufficient dimensions create congestion.

H. C. Coons—"Michigan Experience Shows Advantage of Direct Connection Type Interchanges;" *Engineering News-Record*, Nov. 24.

### Street Maintenance In Kansas City, Mo.

Of first importance in maintaining a city's streets is the complete inventory of the local street condition and the early initiation of a program planned in a general manner several years in advance. This program should provide for immediate repair of local breaks or failures; preventive maintenance; and rehabilitation of existing pavements. We keep informed on the condition of the streets by reports made by the street cleaning foremen and the building and construction inspectors as well as by our own men. In order to arrest pavement deterioration at the earliest possible date, we call on contractors for additional help when our own force is inadequate.

Since 1944 we have repaired and sealed all of our 344 miles of bituminous pavement. The problem of the old concrete pavements is more difficult; the best answer seems to be to replace sections which have failed, correct drainage conditions, and keep the cracks sealed. The most popular improvement is resurfacing old pavements with a 2- or 3-course application of asphaltic concrete, using about 350 lb. per sq. yd. We



Courtesy Engineering News-Record

### ● Y-TYPE intersection at end of Willow Run Expressway.

have done 65 miles of this at a cost of \$1,614,000. We use dump, flat-bed and pick-up trucks, air compressors, pneumatic tampers, concrete mixers, asphalt distributors, tandem, 3-wheel and sheepfoot rollers, road graders, high loaders, and gravel spreaders; also an oil-bath heater for rubberized joint-material, and a crack cleaning and cutting machine.

Reed McKinley—"Kansas City's Street Maintenance Methods, Equipment and Materials;" *Roads and Streets*, November.

### Capacities Of Intersections

"One of the more important elements limiting the capacity of any facility, especially that of city streets, is the intersection at grade," says the Committee on Highway Capacity of the Highway Research Board, in its report on Highway Capacity, published by the Bureau of Public Roads in the December issue of *Public Roads*. The committee found very little published material on the subject, and collected a large amount of data, aided by State highway departments and city officials. Data for hundreds of intersections were assembled and studied and the results are discussed at length under the classifications—"Signalized Intersections," "Weaving Sections; Unsignalized Cross Movements;" "Ramps and Their Terminals," and "Relating Hourly Capacities to Annual Average Volumes and Peak Flows." This is the second half of the report re-

ferred to in the November "Highway Digest," the complete report occupying 75 pages of *Public Roads*.

"Highway Capacity: Practical Applications of Research;" *Public Roads*, December.

### Making A Fill In Deep Muck

The projected Washington-to-Annapolis expressway crosses a salt water inlet some 1100 ft. across, with muck depths of 35 ft. or more. The plan adopted here is to displace some 150,000 cu. yd. of muck, aided by liquefying blasts, and place a 450,000 cu. yd. fill. Heavy blasting was possible because of the remoteness of any buildings. First about 2300 lb. of 50% nitroglycerine dynamite was spread over an area about 250 ft. wide and 40 ft. longitudinally along the edge of the muck, 1 lb. to a hole, pushed to a depth of 2 or 3 ft., spaced 18" apart in rows 7 or 8 ft. apart. After shooting these, a second charge of 1900 lb. was pushed deeper into a similar area ahead. These liquefied the muck so that the fill, which was placed immediately with dozers and scrapers, could settle through it. When this fill had been brought up well above water level, another area ahead was blasted and filled; and this was continued, extending the fill 30 to 50 ft. daily. During the first few weeks the fill settled at the rate of about 1½" per 24 hr., but this has gradually lessened although the fill has been raised to about 20 ft. above water

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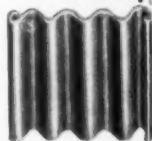
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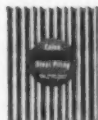
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and carries as many as 700 or 800 round trips of heavy equipment daily.

"Large-Scale Muck Displacement on Maryland Project," *Roads and Streets*, November.

### Trucks For Widely Scattered Oil Patching

The Los Angeles, Calif., Road Department has developed a special hot oil patching truck for use where patching is to be done at scattered points over a considerable mileage. For example, in one district two trucks do all the scattered patching on 1400 miles of road; which patching, however, is kept at a minimum by annual intensive resurfacing. These trucks are not used where considerable travel from job to job is not necessary. Each unit consists of a 10-ton chassis carrying a 6-man cab, a 350-gal. insulated oil tank just behind this, and behind that a flat bed with removable sides used for transporting rock and asphaltic mixtures up to 8 tons. A pump is operated by a take-off from the truck transmission. Exhaust gas is used to heat the oil tank, maintaining it at 400° or even increasing the temperature during the day.

Earle A. Burt—"Hot Oil Road Patchers Expedite Maintenance"; *PUBLIC WORKS*, December.

### Aggregate Retention On Bituminous Seal Coats

Laboratory tests of the above, using different bituminous materials and different aggregates, were made at the laboratory of the Texas Highway Dept. Some of the conclusions from these are as follows: 1—With all other factors the same, the source of asphalt does not have a very pronounced effect upon the amount of aggregate retained, although asphalts of the same penetration do not necessarily have the same degree of fluidity at a given temperature. 2—Aggregate loss shows a gradual increase with decrease in penetration of the asphalt. Also better "asphalt weather", more rolling, etc. are required to obtain the same degree of aggregate retention with the harder grades of asphalt cements than with the softer grades; but the former hold the aggregate more firmly once it has been embedded. 3—There is a decided advantage in adequate rolling, more with cements than with liquid asphalts. 4—Emulsions are very similar to cut-backs in aggregate-retention properties. 5—Aggregate grading can vary considerably without having appreciable effect on retention; but fines hinder the em-

bedding of the larger aggregate in asphalt film.

R. J. Hank and Marshall Brown—"Aggregate Retention on Bituminous Seal Coats," *Roads and Streets*, November.

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Colored Roads in Leyton. Nov. 30, Pp. 19-20.

### Engineering News-Record

Conclusions From Pavement Study Found Lacking Full Support. By Peter C. Hyzer, Corps of Eng'rs, Dept. of Army. Nov. 17, Pp. 40-43.

Michigan Experience Shows Advantages of Direct-Connection Type Interchanges. By H. C. Coons, Chf. Engr., State Hwy Dept. Nov. 24, Pp. 32-36.

### Public Works

What Are Highway Capacities? December, Pp. 25-27, 42.

Hot Oil Road Patchers Expedite Maintenance. By Earle A. Burt, Chf. Div. Road Com'r, Los Angeles Co., Calif. December, Pp. 32-33.

## Rainfall and Runoff

THE Hartford, Conn., Water Bureau, operates 6 weir stations where continuous records are made of stream flows; rain gauge is maintained; evaporation records are kept at two reservoirs during May to October inclusive; also records of the air temperature, humidity and prevailing direction of the wind.

The desirability of each water works keeping its own records, rather than assuming that those of other cities in the same section of the country would be just as serviceable, is indicated by a comparison of rainfall and runoff records for three watersheds of this one city.

In these three watersheds, while the averages of annual rainfalls differ only a little over an inch, the maximums differ by 4½" and the

## Roads and Streets

Kansas City's Street Maintenance Methods, Equipment and Materials. By Reed McKinley, Dir., Dept. of Pub. Wks. November, Pp. 43-45.

Large-Scale Muck Displacement Successful on Maryland Project. November, Pp. 48-52.

Aggregate Retention on Bituminous Seal Coats. By R. J. Hank and Marshall Brown, Engrs., Texas Highway Dept. November, Pp. 72-74.

## Public Roads

Highway Capacity: Signalized Intersections. By O. K. Normann and W. J. Walker, Hwy Transport Research Branch, B.P.R. December, Pp. 237-277.

## Massed Pipes Solve Drainage

The Mimbres Valley in New Mexico is long and flat, and receives heavy run-off during rains. US Highway 70-80 crosses this valley. To provide adequate drainage without raising the road level unduly, State Highway Department engineers installed 183 lines of 30-inch concrete pipe culverts. The centers of the lines are 5 ft. apart and each pipe section is 64 ft. long. This one installation required 11,712 ft. of pipe. Another low spot required 69 lines of pipe; other installations have 43, 26, 21, 17 and 10 pipes.

minimums by 6". Especially interesting is the fact that neither the maximum nor the minimum annual rainfall occurred during the same year on any two of these adjacent watersheds.

Comparing the records of annual runoff in second-feet per sq. mi., we find that, of the two watersheds named, the one with the higher rainfall showed the lower runoff, average, maximum and minimum. Also in neither watershed was the year of maximum rainfall that of maximum runoff, and in one of them the year of minimum runoff was not that of minimum rainfall. Moreover, in every one of these cases the year of maximum runoff was separated by at least 11 years from that of maximum rainfall, showing that no lag between rainfall and runoff was accountable for this.

## RAINFALL (YEARS OF RECORD)

	Nepaug (36 years)	East Branch (36 years)	Res. No. 1, W. Hfd. (80 years)
Year 1948 .....	45.74"	45.28"	46.86"
Average .....	44.86"	44.34"	43.65"
Maximum .....	61.18" (1937)	56.64" (1938)	56.95" (1920)
Minimum .....	34.89" (1930)	33.11" (1914)	28.90" (1935)

## RUNOFF (YEARS OF RECORD) second feet per square mile

	Nepaug	East Branch
Year 1948 .....	1.72	1.93
Average .....	1.64	1.90
Maximum .....	2.48 (1920)	3.26 (1927)
Minimum .....	0.85 (1930)	0.91 (1941)

## THE SEWERAGE AND REFUSE DIGEST

## PUBLIC WORKS DIGESTS

### Cincinnati's Design For Storm Water Inlets

The city engineers of Cincinnati, O., after conducting a series of tests over several years, have changed the plans for sewer inlets, lowering an area of 4 x 15 ft. around the grating; making gratings with bars parallel to the curb, without transverse ribs; and molding diagonal deflectors in the pavement within the inlet area where the street grade exceeds 4%. (Experiments by the Minnesota Dept. of Highways resulted in a different design. See PUBLIC WORKS for June, 1948, Editor).

"Improved Sewer Inlets for Cincinnati;" *Engineering News Record*, Nov. 24.

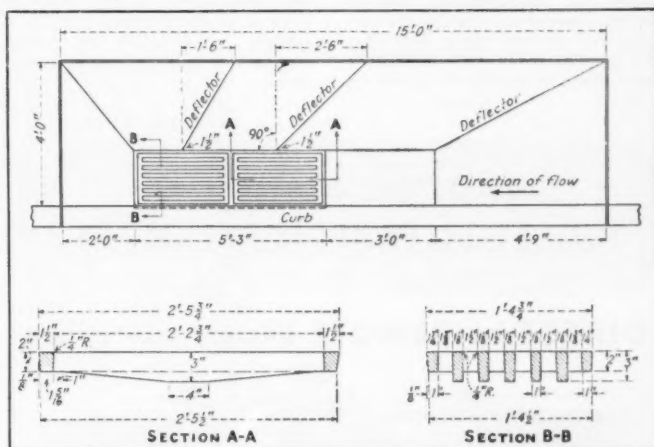
### Removing Sludge From Open Beds

Medina, O., uses about 36,000 sq. ft. of open sludge drying beds at its treatment plant. Prior to 1948 the sludge was removed from the beds by two men with wheelbarrows. Since 1947 an Oliver H. G. 42 Cletrac tractor equipped with a Ware hydraulic front-end loader has been used. The loader bucket has a capacity of 16 to 20 cu. ft. of dry sludge. The tractor, with 10" treads, is driven onto the bed and the bucket filled by hand shovels; then the tractor carries it to a dump, or the bucket can be raised to discharge it directly into a truck. After the sludge has been removed, the sand is leveled by dragging the bucket over it, followed by hand floating. No damage has been done to the underdrains. During 1948 they removed 10,000 cu. ft. of dry sludge, using one man for about one third of the time required for wheelbarrow removal.

"Removing Sludge From Beds with Hydraulic Loader"; *PUBLIC WORKS*, December.

### Bio-Thermal Refuse Disposal

Miami, Fla., has contracted to pay a private company \$390,000 a year to receive the mixed refuse of the city and dispose of it by the Verdier bio-thermal process. This is a de-



● STANDARD grating inlets used by Cincinnati, O.

Courtesy Engineering News-Record

velopment of the Beccari process which was tried in this country about 20 yr. ago and abandoned. In this Verdier process the refuse is pulverized (including ashes and bottles) and placed in cells where air, warmed if desired, can circulate through it. Here aerobic decomposition takes place, being completed in 11 to 21 days and producing a black, earth-like soil conditioner. The equipment required includes a crane, hammermill, conveyors, blowers and pulverizer.

"Miami, Fla., Adopts the Verdier Process of Bio-thermal Refuse Disposal"; *American City*, December.

### Dual-Fuel Engines For Sewage Treatment Plants

By official definition, the dual-fuel engine is "One which uses all oil fuel on the diesel cycle, or predominantly gaseous fuel with oil fuel ignition, and is fully convertible from one fuel to the other." If not instantly convertible, it is called a "gas-diesel". Air and gas for combustion are fed into the cylinder ahead of the compression stroke, at the end of which the fuel is ignited by injecting a small amount of fuel oil into the cylinder. Dual-fuel engines have been developed to the

point where, by comparison with the conventional high-grade spark engine, they require 30% less fuel at full load and 50% less fuel at quarter load to produce 1 hp-hr. By supercharging, the output of any given engine has been increased as much as 75%. They are furnished in sizes ranging from 125 hp to 3,400.

W. R. Crooks—"The Dual-Fuel Engine and Its Application to Sewage Treatment Plants;" *Sewage Works Journal*, November.

### A 10-Foot English Outfall Sewer

In October last, an outfall sewer was officially opened in England whose construction presented some unusual features. This was the Rimrose Brook outfall sewer which drains some 700 acres of three boroughs. The various branches 36" and less in diameter are circular; followed by U-shaped sewers constructed in open cut with sizes from 5' x 4'6" to 10' x 9', constructed of reinforced concrete with brick lining on the semicircular bottom. In tunnel they are constructed of precast reinforced concrete segments, brick lined. In tunneling through an old dump, foul air was encountered and considerable water,

and it was necessary to use compressed air with 4 to 5 lb. pressure. The portion in the Mersey river is 10 ft. diameter, constructed of brick-lined concrete segments in a tidal cofferdam. The cofferdam was designed with the main assumption that the structure might be in a position for a period of at least a year, during which period storms might be experienced, causing waves of maximum 10 ft. height and force of 1 ton per square foot. The two lines of piling were utilized to resist these forces by a system of

internal steel bracing welded to the piling. The internal members were so designed as to leave clear spaces for the building of the complete sewer free from obstruction after excavation. As expected, several very violent storms were experienced but no damage was sustained. The top level of the cofferdam was fixed at 32.50 tide gauge, the highest tide anticipated in calm weather being 31.50. No attempt was made to exclude waves above this height, as this would have been uneconomical.

"Rimrose Brook Main Drainage Scheme"; *Municipal Engineering*, Nov. 25.

### Grease Control By Activated Carbon

The sewage of the Univ. of Miami at Coral Gables, Fla., is treated in an activated sludge plant of 300,000 gpd capacity. The two aerators are of the mechanical type. Last April large amounts of grease began appearing on the surface of the aerators each morning, disappearing by night. Microscopic examination of the mixed liquor showed complete loss of all protozoa. After trying several remedies without result, activated carbon solved the problem. Twenty pounds was fed just ahead of the bar rack, carried by the sewage through the pumps to the primary settling tank, then over a weir to the aerating tanks and through the mechanical aerators of the tube type. Conditions started to improve immediately. The next day 15 lb. was fed and the heavy grease deposits completely disappeared. No more trouble was experienced until about a month later, when three doses of 10, 6 and 8 lb. on successive days again effected a complete remedy. The protozoa returned in great numbers. When the carbon was applied, there was more than 90% reduction of settleable solids in the primary settling tank. It is to be noted that the carbon can not be used in connection with chlorine because of the chemical reaction.

W. C. Tims—"Grease Control in Activated Sludge;" *Sewage Works Engineering*, December.

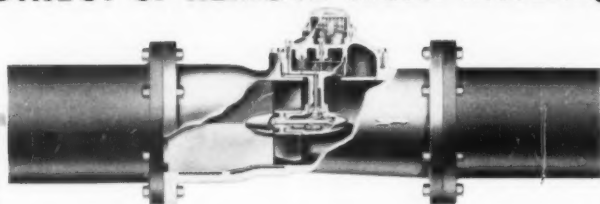
### A Short-Time B. O. D. Test

The author investigated the possibility of using methylene blue as an indicator of the time needed for the disappearance of a limited amount of either dissolved or nitrate oxygen from a sewage sample, and using the procedure as the basis of a short-time B.O.D. test in which time, as indicated by a recording potentiometer, would be the measurable variable in the technique. A combination of a photoelectric cell and the recording potentiometer was used to measure the changes in color intensity of a sewage sample to which a redox potential indicator (methylene blue) has been added. But the results obtained were unsatisfactory.

R. S. Ingols—"A Study of B.O.D. With Time as the Measurable Variable;" *Sewage Works Journal*, November.

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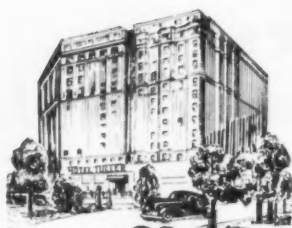
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### Intermittent Sand Filtration In Florida

Experiments have been conducted by the Sanitary Research Laboratory of the Univ. of Florida to determine how conventional sewage treatment methods perform under the higher temperatures there. For studies of intermittent sand filtration, three grades of Florida sand were used, 0.25 mm, 0.45 mm and 0.30 mm; the uniformity coefficients averaging 2.23, 2.79 and 3.26 respectively. Bed depths of 18" and 30" were used for each grade of sand. A year's duration of tests indicated that removal of suspended solids, averaging 89.5 to 95.8%, was independent of loading and temperature but increased slightly with smaller sand and greater depth. At loading rates of 125,000 to 150,000 g.a.d., 93% to 95% removal of B.O.D. can be expected on sand of 0.25 mm; 89% to 93% on 0.30 mm sand, and 83% to 88% on 0.45 mm sand. The low efficiency is due to the fact that the effluent is commonly in the second stage of oxidation. Within the temperature range of 55° to 85°, residual B.O.D. values improve as the temperature rises, especially in the shallower beds and larger sands.

G. R. Grantham, D. L. Emerson and A. K. Henry—"Intermittent Sand Filter Studies," *Sewage Works Journal*, November.

### Fertilizer From Night Soil

In south and central China, the use of excreta collected in the cities as fertilizer on the farms seems to be necessary. But as now used, with untreated excreta stored in the open, more than 50% of the nitrogen is lost, and by far the largest number of illnesses are the result of fecal-transmitted cholera, typhoid and dysentery. A study was made to develop a method of treating the night soil mixed with garbage to produce a sanitary organic fertilizer at a cost less than that of commercial inorganic fertilizers.

Anaerobic digestion at normal temperature destroys the coli-aerogenes bacteria; but the destruction of ascaris eggs, and thereby the elimination of amoeba and worms, requires temperatures approaching 150°F. In good aerobic digestion, thermophilic bacteria raise the temperature of the mass to 140°-150° within two days, and 95% of the ascaris eggs are destroyed. By the end of 25 or 30 days the temperature has dropped and fungus growths then break down the organic matter. The pilot plant as con-

structed contained 2 settling basins, 6 small aerobic composting pits, 1 large aerobic digestion tank, 4 anaerobic digestion tanks, a trickling filter, 2 sludge drying beds, and a bone crusher. In operation, ground and sorted garbage or rice straw was spread in the bottom of the aerobic digestion tanks, then a layer of night soil, and finally a layer of pulverized bones and a small quantity of lime. A carbon-nitrogen relationship of greater than 20 to 1 was aimed at, and a pH of 7.1. Surplus moisture was drained into a pit and pumped back on top of the digesting material. A digestion time of 15 to 20 days is believed practicable. Digested sludge was spread 6" thick on drying beds. Analyses of the sludge showed 3.94% total nitrogen, 1.5% phosphate, and 2.27% potash, and 42% moisture. The fertilizer has a buffered pH which helps to stabilize acid soils, and plus values of humus and bacterial enzymes. It could be sold at much less than equivalent commercial fertilizer.

Ralph Stone—"The Shaoyang, China, Night Soil Fertilizer Reclamation Plant," *Sewage Works Journal*, November.

### Methods Of Heating Sludge

The author describes briefly six methods of heating digestion tanks: 1—Passing steam directly into the digester. 2—Circulating sludge through an ejector, which drew into it heat from burning gas. 3—Pre-heating the raw sludge in a tank in which steam coils are placed. 4—Passing raw or digesting sludge through pipes surrounded by steam. 5—Heating coils mounted on the interior walls of the digester. 6—Circulating sludge through an external type heating system. The first four have been used in very few plants. The fifth is in common use and the sixth is receiving favorable consideration.

External heaters have all operating parts easily accessible. In the external combined heater and heat exchanger a circulating pump circulates the digester contents through a water bath, both rate of circulation and temperature of bath being controlled. In another type a pump circulates the digester contents through a heat exchanger, where the sludge pipe is surrounded by circulating hot water. The latter type seems to give a greater transfer of heat per sq. ft. of heating surface. The former type is more compact and generally less costly. With either



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of them, the heat transfer coefficient is much higher than with heating coils inside the tank.

External heaters are designed to operate continuously; unless the sludge is pumped continuously at a very slow rate, it would pass into the tank only slightly heated. An advantage is that recirculation of the digester contents speeds digestion. The cost of circulating both hot water and sludge must be greater than circulating hot water alone in the coil system, but the greater heat transfer coefficient may offset this. On occasions when unusually large amounts of cold raw sludge must enter the digester, it can be heated more rapidly by the external type heater. The heating coil system costs less to install but may cost more to maintain.

R. A. Greene—"Sludge Heating Methods;" *Sewage Works Journal*, November.

#### Garbage Grinding And Sewage Treatment

No experimental or pilot plant of appreciable size is known to the writer which has been operated using ground garbage from kitchen disposers. The character of garbage

from industrial grinders is not like that from kitchen grinders, which is sure to be nearly pure garbage substance. Garbage from household disposers will have an effect on the treatment process quite different from that where industrial grinders are used discharging directly into digesters.

The writer believes that it will be more than 20 years before half the dwellings in the average community will be equipped with garbage disposers; and even then the sludge load at the sewage plant will not be increased by as much as 20%—more likely it will be 10%.

Mark B. Owen—"Estimating Food Waste Loadings on Sewage Treatment;" *Sewage Works Journal*, November.

#### Pickling Liquor For Conditioning Sludge

Ferric chloride, used by Dearborn, Mich., for conditioning sludge for vacuum filtration and as a coagulant, more than doubled in price during the past few years, the use of steel pickling liquor was tried as a substitute. From tests carried out in 1947, 1948 and 1949 on its use for sludge conditioning it was con-

cluded that such liquor was a very satisfactory substitute for ferric chloride, which would effect a saving of \$1.50 per ton of dry solids, equal to over \$20,000 a year. Its use for precipitation of sewage is being studied also.

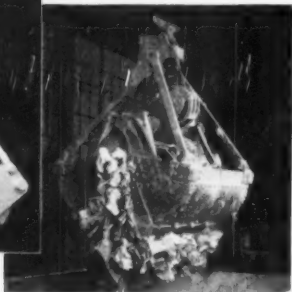
The moisture content of the vacuum filter sludge cake was 6.2% lower, the pounds of dry solids per sq. ft. of filter area per hr. was 15.1% greater, and the lime consumption 8.1% lower, when using pickling liquor than when using ferric chloride.

Michael A. Groen—"The Use of Steel Pickling Liquors For Sewage Sludge Conditioning;" *Sewage Works Journal*, November.

#### Biofiltration at Orlando, Florida

By January, Orlando expects to have in operation a Dorr Biofiltration plant to treat 8 mgd in summer and 16 mgd winter maximum. At present the city's sewage is passed through septic tanks to wells discharging it under ground; which disposal, the State Health Dept. says, is likely to pollute the underground water from which the city draws its supply. The \$3,000,000 cost of the improvement is to be financed

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## Water and Sewage Chemistry and Chemicals

In the operation of modern water and sewage treatment plants, some knowledge of chemistry and chemicals is essential. Whether water is intended for human consumption or industrial use, chemical reactions have a part in its proper treatment. In the disposal of sewage, procedures and controls are based on chemical tests.

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"Biofiltration Plant at Orlando to Protect Florida Waters"; *Sewage Works Engineering*, November.

### Disposal Of Cyanide And Acid Wastes

These wastes, produced at Western Electric's factory at Allentown, Pa., are treated to render them suitable for discharge into the Lehigh river by making them non-poisonous, colorless and odorless. The treatment consists of storage, dilution, and rate-controlled flow of caustic solution to cyanide-destruction and acid-neutralization systems; cyanide destruction by chlor-

ination; and settling and neutralization of acid wastes by cyanide-free effluent as well as by direct addition of caustic. Caustic soda solution is used because, although the highest-priced of the common alkalis, it is easy to unload from tank cars to underground storage, is always available by pumping from storage, is quick of reaction, and leaves no residue.

The cyanide wastes are discharged into a 3,000-gal. underground tank and, when this is full, pumped to a 15,000 gal. tank where, when this is full, they are chlorinated. Chlorination involves adding caustic until the pH is 8.5 or higher, when the chlorine is added until 10 ppm of free chlorine is indicated. These cyanide-free wastes are pumped to a 49,000 gal. basin, where they partly neutralize acid wastes from chemical processes. The effluent from this basin flows to an 8,000 gal. basin, where sufficient caustic is added to complete neutralization.

Allen H. Gibson—"Cyanide Destruction and Acid Neutralization Prevent Poisonous Stream Pollution"; *Engineering News-Record*, Nov. 17.

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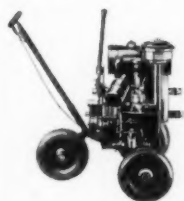
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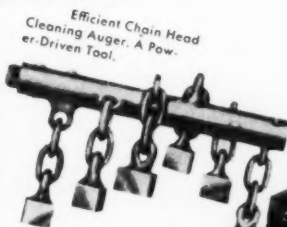
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level rather than with health agencies under the same governmental unit that provides the utility service. The supervision of utility services by a State agency, and in the case of the sanitary aspects of public water supply and sewerage, by the Sanitary Engineering Divisions of the State Health Departments, assures this governmentally sound policy of separating regulatory supervision from operative control.

This is an administrative policy that is almost universal among the States and one that has made it possible to establish and maintain in the several State health departments a high standard of sanitary engineering service that has contributed much to the design and operation of water and sewerage utilities.

This workable relationship between health departments and water and sewerage works personnel that has developed during the years is based on a fundamental engineering concept that in government as elsewhere action should result from the proper evaluation of all pertinent data and that these data should be so presented that a majority of all concerned will have accepted the proposed action before it is imposed by regulation.

## Water and Sewage Personnel Relationships

(Continued from page 45)

It is charged with responsibility for maintaining the standards of service performed by public and quasi-public agencies at a level above the minimum consistent with the preservation of the public health.

In the exercise of its governmental function the Health Department must base its regulatory action on factual data, and to this end it is necessary that inspections be made and that reports be compiled.

Since the quality of service rendered by a utility is dependent on both the physical facilities that have been constructed to render the service and the qualifications of the personnel that operate these facilities, health departments must know and must require that both facilities and personnel are able to meet those standards that are recognized as necessary for the protection of the public health.

While the primary purpose of government as expressed through the activities of a health department is to provide health protection to the public, there is another governmental responsibility that is of especial interest to personnel who operate water or sewerage utility services. The very fact that government through the health department assumes a supervisory responsibility

for the quality of service performed, places with that governmental agency a responsibility to keep such records as might be necessary to establish in court, in the defense of the utility, the quality of service that has been rendered.

The management of a utility, privately or publicly owned, subject to governmental regulation, acquires by virtue of that regulation, a degree of protection against claims of alleged damage. The Health Department must assume inspectional responsibility for the quality of service performed and having performed that function, is obligated to maintain its findings as a part of the public record.

If the inspectional services of a health department are to have real value to a utility and to the consumers of its services it is self evident that they must be performed by well-trained and competent personnel. It is also evident that if the same governmental unit is responsible for both the operation of a utility service in its corporate capacity, and for the inspection of that service in its governmental function, confusion will ensue.

It has not been by chance alone that the supervisory responsibility for water and sewerage utility service has been placed at the State

## Water Hammer and Pipe Surges

(Continued from page 33)

used during previous tests. With a constant rpm there is a surge of plus or minus 30 psi, without the desurger, at an average pressure of 60 psi. When the desurger was installed, and without making any other changes, the surge became plus or minus 1 psi, and the average pressure was 90 psi. It is believed that the overall efficiency of the pump was increased due to more effective operation of the valves when the surges were damped. Special electronic instruments are now being used to continue studies of this nature.

The Fluidynamic desurger, arranged as a through-flow device, proved very effective in decreasing surges and appears to offer a solution to problems of this nature.

**Ed. Note:** Fuller information on the application of this device to water or other fluid problems can be obtained from Valve Engineering and Development Co., 30 Rockefeller Plaza, N. Y. 20, N. Y., or at Tulsa 6, Oklahoma. Much of the data herein are based on experience in handling petroleum products at high pressures, but are equally applicable to hydraulic problems involving water supplies.



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63. Bulletin 167-D describes the Novo lift-and-force diaphragm pumps which feature compact design, easily opened cleanout plate and triple-life diaphragms. 3" and 4" sizes handle water laden with large amounts of debris and abrasives, and containing large percentages of air. Copies from Novo Engine Co., Lansing 5, Mich.

#### Two Handbooks on Asphalt Road Construction and Maintenance

74. Two excellent publications of the Texas Company describe the construction of road surfaces by the pressure distributor method and plant-mixed types of asphalt paving. One gives construction methods and aggregate specifications for asphalt macadam, road-mix surfacing and surface treatment; the other covers procedure for laying sheet asphalt and asphaltic concrete of several types. Also included are a number of useful tables for the road builder. Both of these authoritative booklets may be obtained by using the coupon or writing Dept. PW, The Texas Co., 135 East 42nd St., New York 17, N. Y.

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79. By using the Wallace & Tiernan residual chlorine recorder you can get better chlorination control because you actually see at all times the residual being carried. The 24-hour charts provide a valuable record and check on operating irregularities. More data on what the recorder is and what it does are covered in Bulletin M-20-S. Wallace & Tiernan, Dept. PW, Newark 1, N. J.

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107. Check this new materials spreader for road resurfacing, the "Roadsaver" which spreads ahead of the carrying truck. Driver and spreader operator see what they are doing. Roadsaver fits standard dump trucks; change-over time is 2 minutes. Full details from Gabb Manufacturing Co., 16 Orchard St., East Hartford, Conn.

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#### Useful Data on Tarvia Road Surfaces

94. For full information on the use of Tarvia paving materials for both construction and maintenance of glare-free, smooth-riding surfaces, check the coupon or write to The Barrett Division, Allied Chemical & Dye Corp., 40 Rector St., New York 6, N. Y.

#### New Safety Chart on Chlorine Handling

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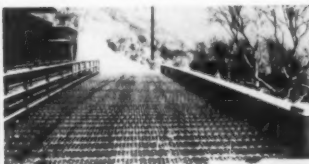
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33. 100% metering as practiced by many cities requires accurate, dependable meters with interchangeable parts. Cut-away views of every part, capacity and size data are all included in handsome American-Niagara water meter booklet available from Buffalo Meter Co., 2920 Main St., Buffalo 14, N. Y.

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38. Literature on Flexible method of cleaning water mains any size from 2" to 72", giving full details and list of nearest representatives in all parts of country. Address: Flexible Underground Pipe Cleaning Co., 9059 Venice Blvd., Los Angeles, Calif.

### Data on Modern, High-Rate Water Treatment Plant

40. This handsome 28-page bulletin gives a comprehensive yet understandably written story of the development of the Accelerator, and explains its principles, advantages, design considerations, operation and applications. Helpful flow diagrams and specifications. For a copy use the coupon or write Inflico Inc., 325 W. 25th Place, Chicago 16, Ill. Ask for Bulletin 1825.

### Quick Way to Locate Leaks and Pipe

57. Leak Locators. Again available to waterworks superintendents, the Globe line of leak locators, dipping needles and pipe finders. Several leaflets describing the original Geophone leak locator, Little Wonder pipe phone, and the Magnetite Dipping Needle. Globe Phone Mfg. Corp., Dept. P., Reading, Mass.

### Cast Iron Pipe and Fittings For Every Need

65. Cast iron pipe and fittings for water, gas, sewer and industrial service. Super-de-laund centrifugally-cast and pit-cast pipe, bell-and-spigot, U. S. Joint, flanged or flexible joints can be furnished to suit requirements. Write U. S. Pipe and Foundry Co., Dept. PW, Burlington, N. J.

### Helpful Data on Hydrants

64. Specifications for standard AWWA fire hydrants with helpful instructions for ordering, installing, repairing, lengthening and using. Issued by M. & H. Valve & Fittings Co., Dept. P.W., Anniston, Ala.

### 88 Page Book Helps Solve Water Problems

71. pH and Chlorine Control. A discussion of pH control and description of comparators, chlorimeters and similar devices. An 88 page booklet. W. A. Taylor & Co., 7304 York Road, Baltimore 4, Md.

### Turbidity, Color and Hardness Removal

77. Modern water pre-treatment with Dorr equipment and methods is described in Bulletin No. 9141, which gives basic design data and flowcharts for pre-treating highly turbid water, color removal or treatment of low turbidity, and softening. Typical analyses for various types of waters are given together with detention times in recommended treatment units. Write The Dorr Co., Dept. FW, Barry Pl., Stamford, Conn.

### How to Estimate Quantity Of Joint Compound Needed

87. The uses of Tegul Mineral-lead for bell and spigot pipe and G-K Sewer joint compound are described in bulletins issued by Atlas Mineral Products Co., Merittstown, Pa. Includes useful tables for estimating quantities needed.

### Handbook for Care of Centrifugal Pumps

127. Every owner of a centrifugal pump should have a copy of this excellent handbook which is packed with sound information on ways to make your pump last longer and give better service. The workings of centrifugal pumps and effects of pump abuse are cleverly illustrated. Data in this helpful booklet applies to all makes of pumps. Published by Allis-Chalmers Mfg. Co., Dept. PW, Milwaukee, Wisc.

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## WATER WORKS (cont.)

### Job Data Offered on New Steel Water Lines

80. A 12-page illustrated report listing pipe diameters, pipe wall thicknesses, line pressures, coatings, engineering personnel, etc., is entitled "A Report of Dresser-Coupled Steel Water Lines in the Year 1948." A copy will be sent by Dresser Mfg. Div., 59 Fisher Ave., Bradford, Pa.

### Tested Jointing Materials

102. "Hydrotite" is a self-caulking, self-sealing joint compound for bell and spigot pipes. For data book and sample write Hydraulic Development Corp., 50 Church St., New York, N. Y.

### Pipe That Is Immune to Tuberculation and Corrosion

104. Transite Pipe. The high strength and low weight of pipe moulded under pressure from asbestos fibre and cement, together with its immunity to tuberculation and corrosion is the subject of a 32-page pamphlet. Johns-Manville, Box 290, New York 16, N. Y.

### Pressure Pipe That Retains Capacity

106. Several bulletins describing the construction of pressure pipe, list of installations, carrying capacity tests, making service connections under pressure, and detail descriptions of several installations. Lock Joint Pipe Co., Box 269, East Orange, N. J.

### Rapid Sand and Pressure Filter Data

109. Rapid sand filters. A complete line of vertical and horizontal pressure filters, wooden gravity filters, and filter tables and other equipment. For engineering data write Roberts Filter Manufacturing Co., 640 Columbia Ave., Darby, Pa.

### Specs for Gate Valves

112. Rigidly inspected gate valves for pressures up to 175 lbs. by R. D. Wood Co. Sizes 2" to 30", for any standard type joint. R. D. Wood Co., Public Ledger Bldg., Philadelphia 5, Pa.

### Handy Catalog Describes Small Hydrants, Drinking Fountains

113. This 32-page catalog describes 34" to 2" hydrants, also street washers, drinking fountains and other water service devices. The Murdoch Mfg. & Supply Co., 426 Plum Street, Cincinnati 2, Ohio.

### Do You Ever Have Leaks to Fix?

124. "You'll want to know about the full line of 'Skinner-Seal' clamps for repairing bell and socket joint leaks and broken mains. Step-by-step procedures are illustrated in catalog 41, a handsome 40-page presentation which shows applications of all fittings. Write M. B. Skinner Co., Dept. PW, South Bend 21, Ind.

### Data on Chlorinizer Now Available

132. Bulletin 840-F2 features the Builders Chlorinizer and shows complete details of apparatus to accurately meter chlorine gas and deliver controlled chlorine-water solution. Positive rate of flow indication, wide metering range. Get your copy of this bulletin from Builders-Providence, Inc., 16 Coddling St., Providence 1, R. I.

### All About Cement-Mortar Lining of Water Mains

133. Here, in a really beautiful booklet, is practically everything you need to know about this method of lining mains in place—the needs, methods, and results that will interest you. Centriline Corp., Dept. PW, 140 Cedar St., New York 6, N. Y.

### Newly Designed Watersphere— the Modern Elevated Tank

146. A handsome leaflet describes the newly redesigned Watersphere, built in capacities from 25,000 to 250,000 gals., 50 to 125 ft. to bottom. Sphere is supported on a single, gracefully curved column. Be sure to investigate this tank of pleasant appearance and modern welded construction. Data from Chicago Bridge & Iron Co., 2115 McCormick Bldg., Chicago 4, Ill.

### Find Buried Pipe The Goldak Way

131. Finding buried pipe is easy with the new Featherweight Goldak Pipe Locator. An easy-to-read illustrated bulletin tells the full story quickly. Address: The Goldak Co., 1544 Glenoaks Blvd., Glendale 1, Calif.

### Faster Pipe Laying With Precaulked and Threaded Joints

140. McWane 2" cast iron water pipe with threaded joints and pre-caulked bell and spigot pipe are described in folder WM-47. Additional data on 3" to 12" centrifugally cast pipe and fittings in folder WL-47, both issued by McWane Cast Iron Pipe Co., Birmingham 2, Ala.

### "Tailor-Made" Pumps Fit Your Requirements

134. Application-Engineered vertical turbine pumps to suit your particular pumping requirements are completely described in Bulletin P-178. Details of optional driving and pumping arrangements clearly illustrated. Get your copy from A. O. Smith Corporation, Dept. PW, Milwaukee 1, Wis.

### Complete Equipment for The Complete Pool

157. Latest equipment for recirculation, filtration, chlorination, softening and pH control are described in Permutit Bulletin No. 2157. Manual and automatic valves explained and many installations diametrically complete specifications given. Permutit Co., 330 West 42nd St., New York 18, N. Y.

### Helpful Book Gives Pipe Flow

159. This handy 40-page pocket size book titled "Measurement of Water Flow Through Pipe Orifice with Free Discharge" explains the Layne pipe orifice method of computing water flow. Includes flow graphs for various size pipes. Layne & Bowler, Inc., Box 215, Hollywood Station, Memphis 1, Tenn.

### What You Should Know About Meter Setting and Testing Equipment

166. Complete details on all equipment and proper methods for meter setting and installation are included in an excellent book published by Ford Meter Box Co., Wabash, Ind. All waterworks men concerned with setting and testing of water meters should have a copy of this book. Write for Catalog No. 50.

## SEWAGE AND REFUSE

### How to Lower Costs Of Refuse Collection

35. For saving trucks, labor and time in city rubbish collection get details of the new Dempster-Kobert described in literature just published by Dempster Bros., Inc., 996 Higgins, Knoxville 17, Tenn.

### Packaged Sewage Treatment— Just Right for Small Places

36. "Packaged" Sewage Treatment Plants specifically developed for small communities—100 to 3,000 population. Write for full description and actual operating data for this type of plant. Chicago Pump Co., 2348 Wolfram St., Chicago 18, Ill.

### How to Make Better Sewer Pipe Joints

37. How to make a better sewer pipe joint of cement-tight, minimizing root intrusion, better alignment of joint. Permits making joints in water-bearing trenches. General instructions issued by L. A. Weston Co., Dept. P.W., Adams, Mass.

### Solve Corrosion Problems With This Special Alloy

41. "Everdur Metal" is title of an 8-page illustrated booklet describing advantages of this corrosion-resisting alloy for sewage treatment equipment, reservoir, and waterworks service. Dept. P.W., the American Brass Co., 25 Broadway, N. Y. C.

### Furnace Data on Low Cost Incineration

49. The new furnace data bulletin issued by Nye gives information on six furnace sizes which may be used in single or multiple units, plus details of special features. Use coupon or write Nye Odorous Incinerator Co., 51 East 42nd St., New York 17, N. Y.

### Design Details for Sludge Collectors

42. Booklet No. P.W. 1982 on Link-Belt Circuline Collectors contains sanitary engineering data and design details. Catalog No. 1742 on Straightline Collectors, contains layout drawings, illustration pictures and capacity tables. Address Link-Belt Co., 2045 West Hunting Park Ave., Philadelphia 40, Pa.

### How You Can Dispose Of Sewage Solids

54. Nichols Herreshoff incinerator for complete disposal of sewage solids and industrial wastes—a new booklet illustrates and explains how this Nichols incinerator works. Pictures recent installations. Write Dept. PW, Nichols Engineering and Research Corp., 70 Pine St., New York 5, N. Y.

### Standard Forms for Concrete Pipe

67. Concrete pipe for sewerage, drainage and culvert projects can be produced quickly and uniformly with Quinn Standard concrete forms. Data on forms for 12" to 84" tongue and groove or bell end reinforced pipe from Quinn Wire and Iron Works, 1621 12th St., Boone, Iowa.

### All Electric Floatless Liquid Level Control

78. Description of operating principles and applications of B/W controls shows the simplicity and many uses of these all-electric, floatless devices. Diagrams of typical installations and engineering data all in bulletin 147 issued by B/W Controller Corp., Dept. PW, Birmingham, Mich.

### Vitrified, Salt Glazed Filter Bed Block

86. An 8-page folder contains instructive design applications and detailed descriptions of Dickey underdrain tile for filter bed bottoms. Diagrams show how air passes up through blocks for filter ventilation. Issued by W. S. Dickey Clay Mfg. Co., 922 Walnut St., Kansas City 6, Mo.

### Complete Catalog for Engineers Shows Sewage Plant Equipment

110. A complete, 44-page catalog gives engineering data on Jeffrey equipment for water, sewage and industrial waste treatment plants including screening, screenings grinders, grit collectors and washers, settling tank collectors, feeders, Floctrols, mixers and other mechanical equipment. Use coupon to get Catalog 775-A, Jeffrey Mfg. Co., Columbus 16, Ohio.

### How to Improve Coagulation and Sludge Conditioning

111. "Ferri-Floc" description and instructions for use in coagulation, sludge conditioning and treating industrial wastes, fully treated in a 24-page pamphlet. Tennessee Corp., 619-27 Grant Bldg., Atlanta 1, Ga.

### Be Sure to Check These Digester Features

117. Floating covers for digesters, their advantages and details of construction, and suggestions for digester operation are contained in a 42-page catalog. Write Pacific Flush-Tank Co., Dept. PW, 4241 Ravenswood Ave., Chicago 13, Ill.

### Get This Data for Your Laboratory

119. "Water and Sewage Analysis," a 32-page booklet, describes and illustrates equipment for making convenient and accurate water and sewage analyses, including comparators, aqua testers and turbidimeters. Hellige, Inc., 3718 Northern Blvd., Long Island City 1, N. Y.

### Need Low-Cost Air For Sewage Treatment?

122. New 20-page booklet shows operating and construction features of Rotary Positive Blowers engineered to fit your need. Air for activated sludge, water treatment; constant vacuum for filtering. Bulletin 22-23-B-13 gives details. Roots-Connorsville Blower Corp., 310 Poplar Ave., Connorsville, Ind.

### An Incinerator Necessity

139. Recuperators featuring silicon carbide heat transfer tubes and fireclay core-busters for maximum efficiency are described and illustrated in Bulletin 11 issued by Fitch Recuperator Co., Dept. PW, Plainfield Natl. Bank Bldg., Plainfield, N. J.

### POWER AND LIGHT

#### Dual Fuel Engines for Municipal Power

27. A new 8-page illustrated bulletin, No. 4811, describes Superior Dual Fuel Diesel engine operation and illustrates the simplicity of controls with fuel conversion by either push buttons or hand lever. Copies are available from Superior Engine Div., Dept. PW, The National Supply Co., Springfield, Ohio.

#### Air Cooled Engines for Hundreds of Applications

137. Tested under severest conditions of

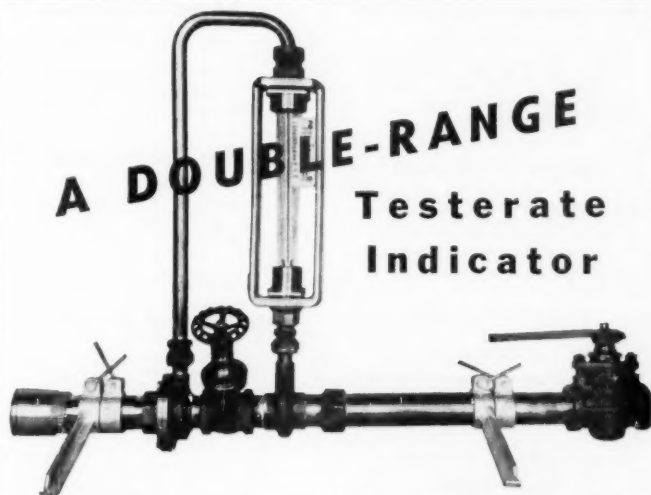
long, hard use, these engines have earned world wide recognition as the "right" power for hundreds of applications. Get latest bulletin from Dept. PW, Briggs and Stratton Corp., Milwaukee 1, Wis.

#### Diesel Engines With Opposed Pistons

143. The opposed-piston idea is joined with principles of diesel combustion to provide economical operation in municipal, private utility and commercial power plant applications. You'll find colorful, detailed data on this remarkable diesel engine in Bulletin 3800-D-1, Fairbanks, Morse & Co., 600 So. Michigan Ave., Chicago 5, Ill.

#### Low Cost Power From Dual Fuel Engines

154. Operating on the Diesel cycle, burning either oil or gas, the Worthington Supercharged Dual Fuel Diesels give high economies by running on the cheapest fuel available. Get complete data from Worthington Pump & Machinery Corp., Dept. PW, Harrison, N. J.



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<p><b>MORRIS KNOWLES, INC.</b> <i>Engineers</i> Water Supply and Purification, Sewerage and Sewage Disposal, Industrial Waste, Valuations, Laboratory, City Planning 1312 Park Building, Pittsburgh 22, Pa.</p>	<p><b>CONSULTING ENGINEERS</b> Your professional card belongs in this directory of leading engineer specialists, where it will be seen by those who employ con- sultants. For rates, write: PUBLIC WORKS Magazine 310 East 45th St., New York 17, N. Y.</p>	<p><b>HENRY W. TAYLOR</b> Water Supply, Sewerage Garbage Disposal, Incineration Industrial Waste Disposal Hydraulic Developments 11 Park Place New York City</p>
<p><b>ROBERT AND COMPANY ASSOCIATES</b> <i>Architects and Engineers</i> ATLANTA WATER SUPPLY • SEWAGE DISPOSAL • INCINERATORS • POWER PLANTS</p>		<p><b>EMERSON D. WERTZ AND ASSOCIATES</b> <i>Municipal Engineers</i> Waterworks, Drainage, Refuse Disposal, Sewerage, Streets, Industrial Wastes 116½ East High Street, Bryan, Ohio</p>

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Operators of Roberts-equipped filtration plants have been telling us for years that our continuing interest in helping them keep their plants at peak efficiency, is a service on which they depend — from incidental replacement parts to million gallon per day additions.

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BY  
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DARBY, PENNA.

**ROBERTS FILTER  
MANUFACTURING CO.**  
640 COLUMBIA AVE., DARBY, PA.

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### FOR REPAIRS OF

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UNUSUAL mixing principle means better coating of aggregate—less waste—faster output. Owners have reported savings as high as 50% per ton of asphalt.

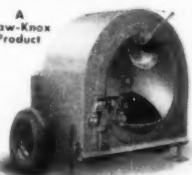
Handles any mix—fully portable—turns out 3 cu. ft. in 30 seconds—built to give long service. Ask for Bulletin K-100.

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Kinetic  
mixer

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Blaw-Knox  
Product

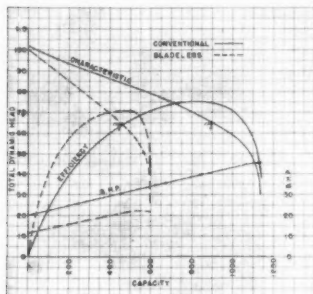


# PUBLIC WORKS

## Equipment News

### Bladeless Non-Clogging Sewage and Trash Pump

This is a new type of pump designed to handle sewage and other liquids containing solids. It is



**Sewage and trash pump curves.**

claimed to be less than one-tenth as likely to clog as conventional pumps when handling fibrous trash. For any specific solid size, the new pump delivers one-half the capacity of usual pumps, and uses smaller motors. Also, the new pumps can be used to replace existing pumps without any changes in piping, shafting or setting. The illustration herewith shows pump characteristics. For full data write Fairbanks, Morse & Co., 600 South Michigan Ave., Chicago 5, Ill., or use the coupon.

Use coupon on page 69; circle No. 1-1

### Aggregate Spreader and Pavement Layer

This self-propelled aggregate spreader accurately lays all base and surface aggregates, free-flowing bituminous mixtures and plant-mixed stabilized soils. It lays any size of aggregate up to 4-inch, in thicknesses up to 10 ins. Accuracy is insured by long straightedge runners. Adjustment is easy for widths of 8 to 12½ ft. Bulletin SPS-9 gives full details. Jaeger Machine Co., Columbus 15, Ohio, or use the coupon.

Use coupon on page 69; circle No. 1-2



**8-yard rubbish container.**

### Water Tight Composite Rubbish Container

This is an 8-yard container for rubbish. It is water tight so as to avoid local contamination if wet wastes, as garbage, are dumped into it through the doors. The Dempster-Dumpster hoisting unit picks up these pre-loaded containers and removes them to the disposal area. All operations are hydraulically controlled. Only one truck and one man are required. Full data from Dempster Bros., Inc., Knoxville, Tenn., or use the coupon.

Use coupon on page 69; circle No. 1-3

### Trap for Sewer Catch Basin

This trap fits into the catch basin and eliminates the hand labor of cleaning. It is lifted from the catch basin into a truck by a portable

crane on the truck and emptied. All the hard hand labor is eliminated. It can be made to fit almost any catch basin. It is light and strong and has lugs for lifting. Write



**Easy catch-basin cleaning.**

Charles W. Lundy, 621½ Liberty Ave., N. Charleroi, Pa., or use the coupon.

Use coupon on page 69; circle No. 1-4

### Ditch, Berm and Shoulder Cleaner and Loader

This machine will pick up and load into trucks any type of material which can be windrowed and will pass up a conveyor belt. This includes dirt, sod, sand, gravel, oil-



**Aggregate spreader and pavement layer.**

for **BETTER  
SERVICE**



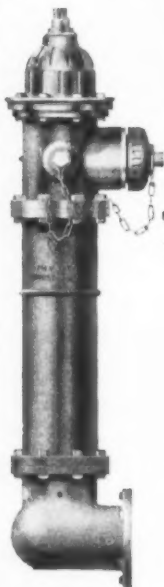
## HYDRANTS VALVES

and  
**WATER WORKS  
ACCESSORIES**

A. W. W. A. type iron body, bronze mounted with double-disc parallel seat or solid wedge type. Non-rising stem, outside screw and yoke, or with sliding stem and lever. Also furnished hydraulically operated. Square bottom type operates in any position.



M & H furnishes both regular type A.W.W.A. fire hydrants and special Traffic Model designed to yield at the ground line under impact.



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### M & H PRODUCTS INCLUDE—

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Extension Stems  
Mud Valves  
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## M & H VALVE

AND FITTINGS COMPANY  
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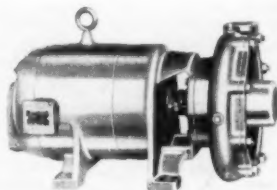
**For ditch, berm and shoulder improvement.**

mix, and snow. It is intended especially to pick up and load the sod cut out of ditches and off berms, but it is also adapted to any kind of loading and pick-up work. You can get information on this useful machine by writing J. D. Adams Mfg. Co., Indianapolis, Ind., or by using the coupon.

Use coupon on page 69; circle No. 1-5

### High-Efficiency Close Coupled Centrifugal Pump

These pumps are for general municipal and industrial use, irrigation and drainage. They will handle



**Close coupled centrifugal.**

water, and also liquids and solutions up to 2000 viscosity. Low maintenance costs are claimed, due to special features of design. Available in cast iron, bronze, bronze-fitted and special alloys. Bulletin from Gorman-Rupp Co., Mansfield, O., or use the coupon.

Use coupon on page 69; circle No. 1-6

### Permanent Aluminum Reflectors

Reflecting warning signs of aluminum, non-glare, with an aluminum oxide surface that retains its brightness indefinitely, are now available. These are made in all of the usual warning and directional sign types. Ten-year exposure tests on these reflectors have shown only a 3% loss in reflectivity. Available plain or colored. Write Par Inc.,

Covington, Ky., for information on the reflectors, and American Fabricators, Inc., 500 East Main St., Louisville, Ky., for signs; or use the coupon.

Use coupon on page 69; circle No. 1-7

### Protective Coating Easily Applied

This self-priming vinyl base paint adheres tightly to metal, wood or concrete. For normal conditions, two or three coats gives long-time protection; either brush or spray applied. Excellent resistance is provided against fumes of almost all acids and alkalies, as well as humidity, grease, oil and alcohol. The paint is softened by aromatic hydrocarbons, ketones and esters. Airdries and is non-inflammable; upper temperature limit about 200° F. This is series "K" Tygon. Information from U. S. Stoneware Co., Akron, O., or use the coupon.

Use coupon on page 69; circle No. 1-8

## CLASSIFIED ADVERTISEMENTS

### HELP WANTED — MALE

MAINTENANCE SUPERINTENDENT. Varied experience in general Street and Sewer Maintenance and Construction required. Salary step plan, \$341 to \$426 per mo. Civil Service, vacation, sick leave, retirement plan, medical insurance. Address replies to City Engineer, P.O. Box 391, Redwood City, Calif.

### MAGNETIC DIPPING NEEDLE \$17.50

with 3 section  
telescoping handle  
\$22.25

Write Today for  
68-Page Catalog  
W. S. DARLEY & CO.  
Chicago 12



### Maintaining More Miles of Road

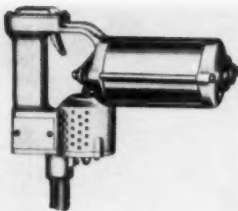
The "Roadsaver" is a spinner disc-type spreader which spreads surfacing material ahead of the truck. This is accomplished by a belt conveyor which brings sand,



**Roadsaver aggregate spreader.**

cinders or crushed stone forward underneath the truck. Width of spread can be varied from 4 ft. to 20 ft., and the density can be controlled by merely varying the speed of the belt. It can be used on any truck with 8.20 or larger tires. Changeover is easy and rapid. Full information from Gabb Mfg. Co., 16 Orchard St., East Hartford 8, Conn., or use the coupon.

Use coupon on page 69; circle No. 1-9



**Light electric hammer.**

### Portable Electric Hammer Helps in Drilling

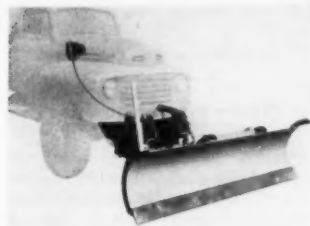
Entirely self-contained, this new electric hammer is light and can be carried on ladders, on scaffolds, or in manholes or excavations. It uses 110-volt AC, and handles drills up to 5/8-inch. A complete line of carbide-tipped, tri-point star drills are available to use with it. Write Syntron Co., 660 Lexington Ave., Homer City, Pa., or use the coupon.

Use coupon on page 69; circle No. 1-10

### To Convert Snow Plows and Mowers to Hydraulic Lift

A handy conversion kit permits adapting snow plows and mowers

to a power hydraulic lifting system. The unit is easily installed and replaces either hand or mechanical



### Converts to hydraulic lift.

lifts. It requires no change in rams or lifting arms. No belts or power takeoffs are required. Control is instantaneous. For information, write Doanell Hydraulic Co., Garden Prairie, Kansas, or use the coupon.

Use coupon on page 69; circle No. 1-11

### Traffic Zoning Paint That Lasts

This paint dries in 20 to 30 minutes so that traffic does not damage it, and it gives exceedingly long wear. Only one coat is needed and it can be applied by the excellent traffic marking machines now avail-

## More EFFICIENT HEATING

### OF SLUDGE DIGESTION TANKS WITH P.F.T. DIGESTER HEATER AND HEAT EXCHANGER

Sludge is circulated through the P.F.T. Digester Heater. Sewage sludge gas, oil or gas fired or combination. Also heated by engine jacket water. Does away with constantly decreasing heat transfer. Eliminates labor of cleaning tank coils. Scores in use—ask for list. Write now for Bulletin 135!

## PACIFIC FLUSH TANK CO.

SEWAGE TREATMENT EQUIPMENT EXCLUSIVELY SINCE 1931

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### THE "Quinn Standard" FOR CONCRETE PIPE

The Quinn Standard is known as the best the world over, wherever concrete pipe is produced and used. Backed by over 35 years service in the hands of hundreds of Quinn-educated contractors, municipal departments and pipe manufacturers who know from experience that Quinn pipe forms and Quinn mixing formulas combine to produce the lowest concrete pipe at lowest cost.

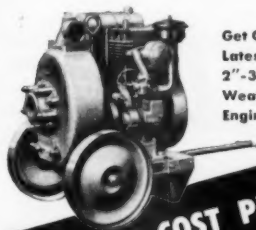
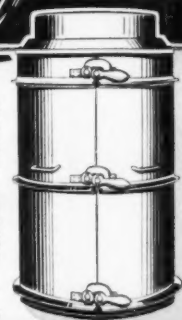
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For making pipe by hand methods by either the wet or semi-dry processes. Built to give many years of service—sizes for pipe from 10" up to 120" and larger—tongue and groove or bell end pipe at lowest cost.

WRITE TODAY. Complete information, prices, and estimates sent on request.

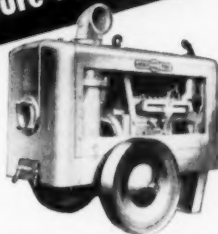
Also manufacturers QUINN CONCRETE PIPE MACHINES

**QUINN WIRE & IRON WORKS 1621 12<sup>th</sup> ST. BOONE, IA**



Get Our New Low Price on Latest Heavy Duty 2"-3" Models with Weather-Shielded Engines.

**LOW COST PUMPING with Jaeger Sure-Primes**



For actual priming speed, vacuum, capacity and pressure, for gallons of water moved per gallon of fuel, for self-cleaning ability, freedom from breakdowns and hours of service per dollar of purchase cost, your Jaeger distributor invites you to compare a Jaeger "Sure Prime" with any pump of like size and rating on the market.

4", 6", 8", 10" Pumps: Standard models to move big volume at low cost. "Pressure" models for work requiring higher heads.

Jaeger housings provide bigger fuel tanks and easier accessibility to engines—an exclusive feature.

**THE JAEGER MACHINE COMPANY, Columbus 16, Ohio**

COMPRESSORS • MIXERS • HOISTS • PAVING EQUIPMENT



able. Marks streets, parking lots, factory floors or any other place where traffic lines are needed. Write Thomson-Porcelite Paint Co., 330 Race St., Philadelphia 6, Pa., or use the coupon.

Use coupon on page 69; circle No. 1-12

### Plastic Pipe up to 6-inch Diameter

Carlton "EF" plastic pipe is practically unbreakable, but has a somewhat lower tensile strength than normal water pipe. It is light in weight, flexible, resistant to corro-



Plastic pipe is light.

sion and long-lasting. A 25-ft. length of 6-inch pipe weighs 55 pounds.

**A  
DEPENDABLE  
JOINTING  
COMPOUND**

**FOR BELL  
AND SPIGOT  
WATER MAINS**

# HYDRO-TITE

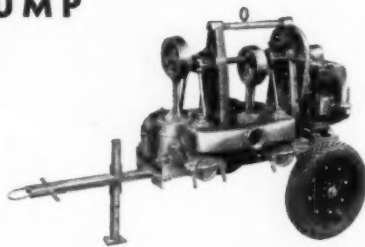
**HYDRAULIC DEVELOPMENT CORP.**  
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50 CHURCH ST. N.Y.C. • W Medford Sta. Boston, Mass.

## NOVO QUALITY EQUIPMENT FOR FIFTY-NINE YEARS

### A NEW PUMP

- DOUBLE DIAPHRAGM
- DOUBLE CAPACITY
- DOUBLE DUTY

Handles twice the amount of muddy, or sand and debris-laden water as does Novo's well-known single diaphragm model. Write or wire for specifications on this new pump.



WRITE FOR NEW BULLETINS

ON THE NOVO TO FIT YOUR NEEDS

 <b>SELF-PRIMING PUMPS</b> 1 1/2" to 6" 1,000 to 90,000 G.P.M.	 <b>PRESSURE PUMPS</b> Sumpers or Booster 200 P.S.I. 15 to 94 G.P.M.	 <b>PAVEMENT BREAKERS</b> 1,000 lb. Drop Hammer Mounted on 1 1/2" Tow Truck	 <b>ENGINES</b> Air-cooled, 4 to 8 H.P. Water-cooled, 10 to 32 H.P.
 <b>DIAPHRAGM PUMPS</b> 1" or 4" Single or Double 1,000 to 10,000 G.P.M.	 <b>HOISTS</b> Single or Double Drum 1,000 to 6,000 lb. Line Pull		

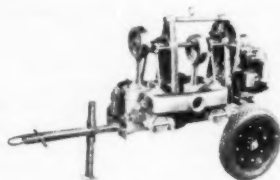
**NOVO ENGINE COMPANY, LANSING, MICH.**

One man can make the joints, using stainless steel fittings, in 2 minutes, according to the manufacturers. Draining the pipe in cold climates is not of critical importance. The 6-inch pipe is suitable for working pressures of about 70 pounds and temperatures up to 140°F. Write Carter Products Corp., 10217 Meech Ave., Cleveland 5, O., or use the coupon.

Use coupon on page 69; circle No. 1-13

### Double Diaphragm Dewatering Pump

For pumping muddy, or sand and debris-laden water, and for all dewatering work, Novo has a new



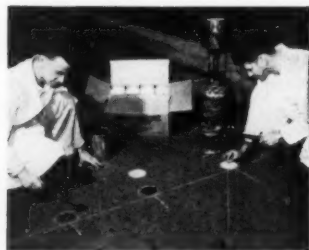
Double diaphragm pump.

double diaphragm pump which is much like their single unit, but of double the capacity. Complete specifications from Novo Engine Co., Lansing, Mich., or use the coupon.

Use coupon on page 69; circle No. 1-14

### A Plastic Disc for Street Marking

These "Dur-O-Line" markers are easily applied to the streets and are highly visible for guiding traffic. They are designed to withstand traf-



Plastic streets markers.

fic 15 times as heavy as the maximum legal load, and are furnished in white or yellow. Two workmen can install 100 markers per hour. Application is by mastic adhesive and pins to bituminous surfaces, and by means of a 1/4-inch hole in concrete. Information from Traffic Safety Supply Co., Portland, Ore., or use the coupon.

Use coupon on page 69; circle No. 1-15

**Diggster on crawlers.****Diggster on Crawlers or Rubber**

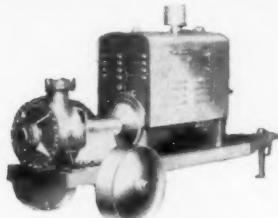
Crawler type traction is now available on the Dempster Diggster, which is also mounted on rubber. The crawler mounting is on the International TD-9 tractor. Gross weight is about 21,000 pounds; buckets from 1 yd. to 2 yds. capacity can be used. For details, write Dempster Bros., Inc., Knoxville, Tenn., or use the coupon.

Use coupon on page 69; circle No. 1-16

**Self-Priming Jetting Pump**

This pump has a capacity of 400 gpm at 150 lbs., and is especially useful for jetting piles, bank wash-

ing, hydraulicking, caisson work, watering down fills and mud pumping. It is primed by the engine ex-

**Sterling jetting pump.**

haust. Made in single and multi-stage models. Ask for data on Model HP 150, from Sterling Machinery Corp., 405 Southwest Blvd., Kansas City, Mo., or use the coupon.

Use coupon on page 69; circle No. 1-17

**Measuring and Controlling Liquid Levels**

"Levelimeter" instruments indicate, measure and control liquid and interface levels. The following are illustrated and described in Catalog Section 75: Magnetic tape-and-

drum, electronically transmitting, ball-float, pneumatic and differential pressure units. V-notch weir and Parshall flume flowmeter instruments; and chemical service sight gauge glasses. Write Fischer & Porter Co., Hatboro, Pa., or use the coupon.

Use coupon on page 69; circle No. 1-18

**PERSONAL NEWS**

Mark B. Owen has opened an office as consultant at 1920 North Meridian St., Indianapolis 2, Ind., and will specialize on municipal and industrial refuse, sewerage, industrial waste treatment and water supply.

Miles O. Sherrill has become principal engineer with Maurice L. Miller, consulting engineer, Louisville, Ky.

Captain Joseph L. Jelley, Jr., Civil Engineer Corps, U. S. Navy, has been appointed Chief of the Bureau of Yards & Docks, with the rank of Rear Admiral. He succeeds Admiral John Manning, who will retire from active duty. Capt. Archibald D. Hunter will become Deputy Chief of the Bureau.

**WHY MUNICIPALITIES  
BUY THE****FRINK****MULTI-  
FEATURE****SNO-PLOWS**

Over twenty years of snow removal experience in all types of snow conditions have made the Frink Sno-Plow superior for the rugged and continuous service necessary for cleaning the nation's highways, streets and airports.

Frink's fifteen Sno-Plows are scientifically built for faster, more economical snow removal.

Each one of these Frink plows is actually built to fit all snow conditions of some particular area.

The Frink Sno-Plows are built for trucks from a capacity of 1½ tons to 12 tons.

Write Box P49W, Clayton, New York, for further information.



**FRINK SNO-PLOWS, INC., CLAYTON, NEW YORK**

**DAVENPORT-BESLER CORP., DAVENPORT, IOWA**

**FRINK SNO-PLOWS of CANADA, LTD., TORONTO, ONT.**

**MORE FEATURES:**

1. Self-ballasting
2. No side-thrust
3. Will not wedge
4. Safer at high speed
5. Easier to push
6. More economical

## SPECIFY

There's a world of difference in what you get when specifications clearly call for MURDOCK Hydrants, Drinking Fountains and Hose Boxes.

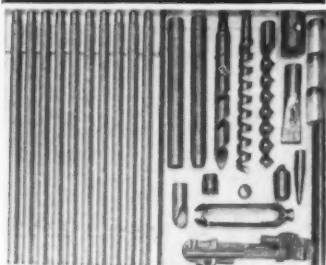
When specifications call for "MURDOCK" you're sure of getting dependable, non-freezing, self-draining fixtures that give minimum trouble and lowest upkeep cost.

Specify MURDOCK and save yourself worry and grief as well as dollars for your taxpayers.



The Murdock Mfg.  
& Supply Co.  
Cincinnati 2, Ohio

## SOIL SAMPLING KIT



### • 12 soil and earth sampling tools in handy steel box.

- Can be carried in any automobile.

36 years experience has proved these tools will recover accurate samples from practically all earth materials.

• MANY USES—brick and clay materials—foundation test borings—gold bearing sands—kaolin and clay for ceramics—sand and gravel pits—subgrade testing for highways and airfield runways—base materials.

- Send for Bulletin 26

**ACKER DRILL CO., INC.**  
SCRANTON 3, PA.

## WORTH TELLING . . . By Arthur K. Akers

We are sure there are many who will share our regret at chronicling the sudden death of John W. ("Jake") Van Atta, vice president and general manager of the **Ralph B. Carter Company**, Hackensack, N. J., which occurred on December 7th. He was serving as a director of the Water and Sewage Works Manufacturers Association and was widely known in the water and sanitation fields.

Col. Bernard E. Gray, for some years past general manager of the **Asphalt Institute**, New York, moves up again. This time to president.

The **Galion Iron Works and Manufacturing Company**, Galion, Ohio, has two new distributors on their list: **Road Material and Equipment Co., Inc.**, at Jackson, Miss.; and **Western Equipment Company**, Boise, Idaho.

**W. A. Riddell Corporation**, Columbus, Ohio, announces **Stockberger-Seaström** of Indianapolis and **Fort Wayne, Ind.**, to handle sales and service of **WARCO** motor graders and **HERCULES** road rollers in all of Indiana except the area contiguous to Chicago. Also, **Frank Thompson** becomes district representative for the Southeast, in Atlanta.



A. G. Crockett

Here is the new manager of distributor sales for **Mack-International Motor Truck Corporation**, **Albert G. Crockett**. In his new position Mr. Crockett will head up Mack's entire domestic and Canadian wholesale organization of some 500 distributors, with headquarters in the **Empire State Building**, New York.

**James H. Percy** now represents **Nep-tune Meter Company** in Louisiana. Incidentally, when we think of water meters now we think of how badly New York City needs them as its largely-waste-induced water shortage fluctuates between critical and chronic!

**Aluminum Company of America** announces from Pittsburgh that **B. J. Fletcher** is now its chief hydraulic engineer. He was formerly chief engineer of the company's development division, and holds a meritorious citation

from the U. S. Government for his work in connection with the "A Bomb."

Below we present **Dan R. Gannon**, new water meter sales supervisor in the Chicago area for **The Pittsburgh Equitable Meter Division** of **Rockwell Manufacturing Company**. He comes from Dallas, succeeding **Ross Burns**, transferred to the Pacific Coast.



A. N. Zahniser



D. R. Gannon

Above we give you the likeness of **A. Newton Zahniser**, new northeastern representative of **Dresser Manufacturing Division**, who will call on water works men henceforth in New England and eastern New York and Pennsylvania.

The newest "face" around the **American Well Works**, Aurora, Ill., is that of their new **MANUAL No. 149** on modern processes and equipment for sewage and industrial waste treatment. All you have to do to get yours is to write the company for it, on your letterhead.

**H. Engesser**, president of **Engesser Electric Manufacturing Company**, up in Watertown, N. Y., has a new water pipe thawer that looks good to us this cold weather. A new circular on it is yours for the asking.

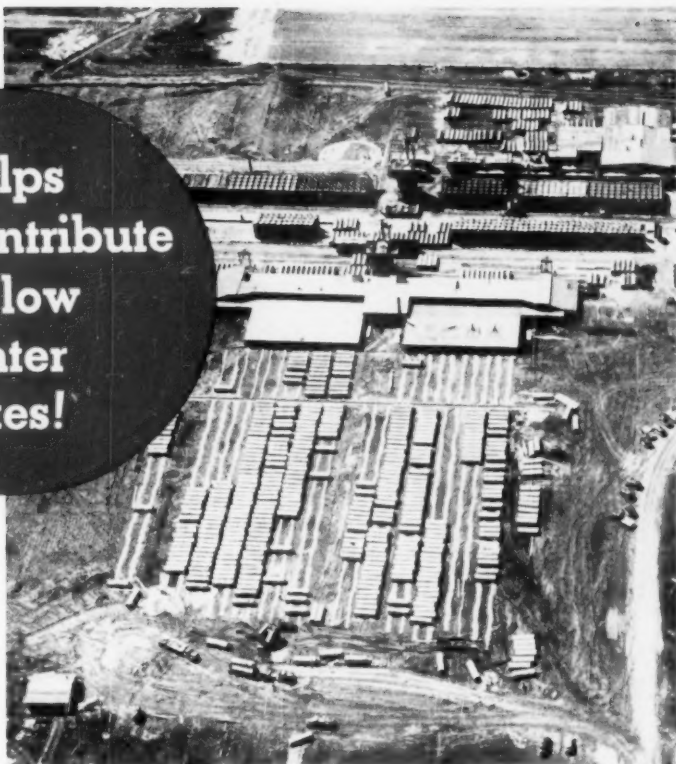
A pleasant hour with **Normand F. Smith**, sales manager of **Gabb Manufacturing Company** at East Hartford, Conn., the other day included a free color movie and its glimpses of something radically new in a road surface material spreader which he calls their "Roadsaver." Any distributor interested in taking it on will get Mr. Smith's full and serious attention.

In lighter vein, there's the story of the Alabama colored draftee in World War I who was being groomed for the cavalry "Naw, suh!" he objected violently. "When that bugle blows 'Retreat' I don't want to have to stop and mess with no horse!"

# LOCK JOINT PIPE

helps  
contribute  
to low  
water  
rates!

*A temporary Lock Joint pipe plant at the site. Use of local labor and materials returns to the community a large part of the pipeline cost.*



Although a modern water supply system represents a sizeable investment, sound engineering makes it possible to keep water rates at a minimum.

Knowing this, economy-minded water supply engineers specify Lock Joint Reinforced Concrete Pressure Pipe for mains of 16" or larger. Lock Joint's low initial cost, its long life, its exceptionally high carrying capacity and its negligible maintenance cost assure the utmost service for the consumer's dollar.

Water works officials who have installed Lock Joint pipe lines point to these lines as the most economical in their entire systems.

*We shall be glad to discuss your requirements. Simply write or call our nearest office.*

*Lock Joint's easy installation means low laying cost.*



## LOCK JOINT PIPE COMPANY

*Est. 1905*


P.O. Box 269, East Orange, N. J.

PRESSURE PIPE PLANTS: Wharton, N. J. • Turner, Kan. • Detroit, Mich.

BRANCH OFFICES: Cheyenne, Wyo. • Denver, Colo. • Kansas City, Mo. • Valley Park, Mo. • Chicago, Ill. • Rock Island, Ill. • Wichita, Kan. • Kenilworth, N. J. • Hartford, Conn.

SCOPE OF SERVICES—Lock Joint Pipe Company specializes in the manufacture and installation of Reinforced Concrete Pressure Pipe for Water Supply and Distribution Mains in a wide range of diameters as well as Concrete Pipe of all types for Sanitary Sewers, Storm Drains, Culverts and Subaqueous Lines.

**LOCK JOINT**  
*Reinforced Concrete*  
**PRESSURE PIPE**

An illustration of several US dollar bills falling from the top left corner of the page. The bills are shown in various orientations, some partially cut off by the edge of the frame.

# Sewage Treatment Dollars are bigger *with* Chlorination

Chlorination, fitted to your specific needs by W&T Engineers, gives you more treatment facilities per dollar than any other single treatment adjunct. It can be put to work at your plant for less than 1% of total plant cost in most cases. And for that 1%, chlorination by W&T is on the job ready to overcome such troubles as ODORS, PLANT OVERLOAD, FILTER PONDING, GREASE, and SLUDGE BULKING, wherever and whenever they develop.

Of course, to get these results, chlorination must be correctly applied. That's where W&T's 35 years of experience come in. Experience plus sturdy W&T Equipment—designed to take hard intermittent sewage plant use—adds up to one sure fact—that you will have the proper equipment, properly installed, to do a thorough job at low cost.

Call your nearest W&T Representative, now, for complete details on the full line of W&T equipment for effective sewage chlorination.

## WALLACE & TIERNAN COMPANY, INC.

CHLORINE AND CHEMICAL CONTROL EQUIPMENT  
NEWARK 1, NEW JERSEY • REPRESENTED IN PRINCIPAL CITIES

